SCIENTIFIC AMERICAN

JUNE 1926

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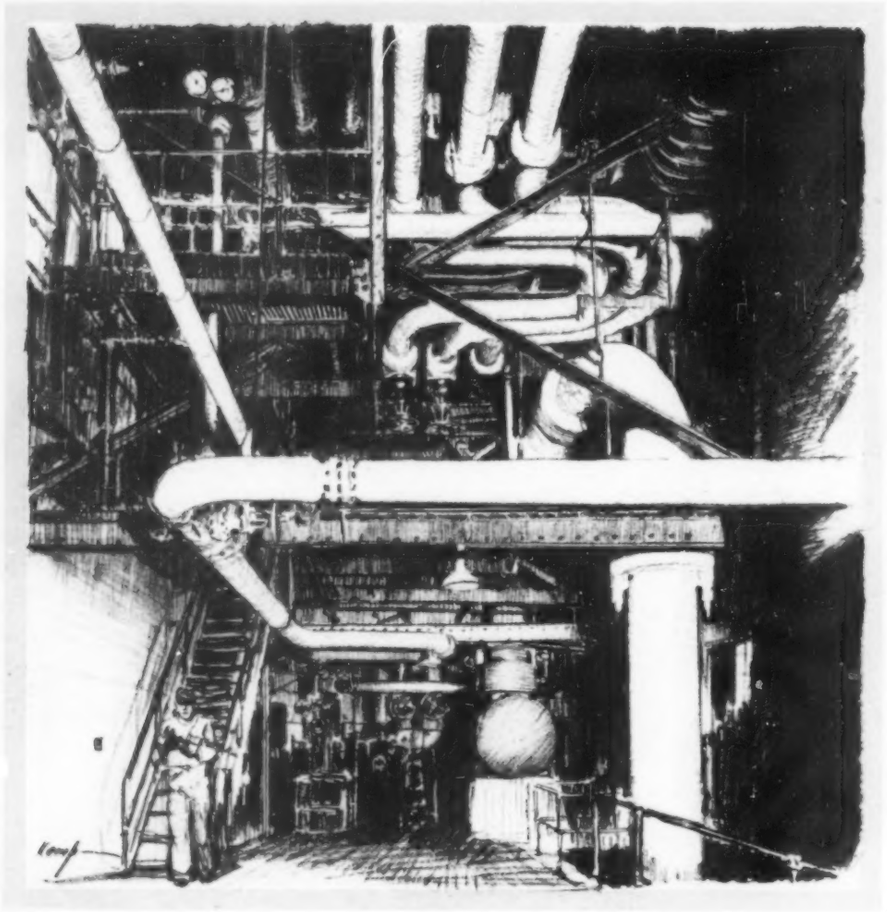

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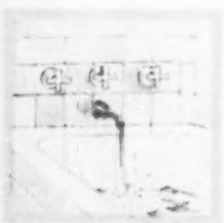

For dependability of product for the purpose always specify Crane.

A view in the header room, Crawford Avenue Station of Commonwealth Edison Company, Chicago. Two 50,000 kw. and one 60,000 kw. turbo-generators are served by 15 boilers already installed. A 77,000 kw. turbo-generator and 5 more boilers now being added. Pressure 600 pounds; temperature 750°. Sargent and Lundy, Chicago, engineers. Graham Anderson Probst and White, architects. Piping installed by W. A. Pope, Chicago.

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THE SCIENTIFIC AMERICAN, June, 1926. Volume 134, Number 6. Published monthly by Scientific American Publishing Company, at 233 Broadway, New York, N. Y., and printed in the U. S. A. Subscription price, $4.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, JUNE, 1926 EIGHTY-SECOND YEAR

ARCTICS

WHY should seven expeditions be headed for the North Pole?

The answer is that finding the Pole is not the main objective of these explorers; they wish to explore unknown lands of vast extent believed to lie about the Pole. A short air route from America to Asia may be charted. These lands may hold mineral resources of vast wealth; the country claiming sovereignty over them by right of exploration and discovery may through them enhance its wealth many times in future years. It is to the interests of science and civilization generally that they be put on the map.

WASTE

THE waste of public funds by the politicians is proverbial. One of the latest instances of this is the voting of $250,000 by the Committee of the House for a new survey of the so-called "all-American" waterway from the Great Lakes to the sea. Such a survey was made years ago by the Army Corps of Engineers and they reported against the advisability of the project. In spite of the alluring "all-American" title, the army engineers who are accustomed to dealing with cold hard facts, are certain to report once more that although such a canal can be dug, its cost will be so great as to be prohibitive. The estimated cost is about 500 million dollars. If the canal should be built by the Government, the politicians will get their finger in the pie—trust them for that—and when they do, the cost may mount to heaven-knows-what figure. These gentlemen tell us that the ship canal will pass through a rich revenue-producing section of the country, and that the factories on its banks will be heavy shippers. As a matter of fact, they will neither load nor unload a ton of freight from big lake steamers of 5,000 to 10,000 tons, for such ships will never tie up at a local dock to break out a small shipment from their holds.

CERTIFIED

A LAW has been passed in Turkey under which all persons who wish to marry must submit to a medical examination, according to the European Division of the Department of Commerce. In order to prevent substitution of a sick person for one who is well, the examining physician must stamp the left forearm of the marriage candidate. This serves as a distinguishing mark to guide the authorities in granting the marriage license.

A capital idea! We have certified milk, certified eggs and certified bonds. Why not certified wives and husbands?

In This Issue

How Burbank "Created" Plants
What many people thought was Burbank's natural "gift" for creating new and better plants was largely a clear-headed understanding of Nature's age-old methods of doing the same thing. In a remarkably revealing posthumous article the late Mr. Burbank tells others how to carry on his work. Page 365.

How Hot Is the Earth's Interior?
New knowledge, new methods, have taught science new facts concerning the hidden center of the earth—it is not so hot as we thought it was. On page 370, Dr. F. W. Clarke, noted government scientist, discusses this interesting question.

"Hey, Fellers, the Sap's Runnin'!"
Do you remember the days when you tapped your maple trees, and if you could, the neighbors' also? How the spring sap oozed out! What was it that made that sap rise? Science has solved the interesting problem and there are some surprises in it. Page 378.

Make Your Boy a Scientist
Perhaps he will never grow rich—few scientists do—but you will be proud of him. There is no saner, healthier way to turn a boy's mind towards serious things than to make a scout of him. Put this magazine where the boy will "accidentally" find it—thereby you may plant a seed. Page 382.

Radio Chatter from the Arctic
The aviator-explorers in the Far North will try to reach you by radio. If you own a short-wave set you may pick up all kinds of good stuff, straight from the Far North. Page 389.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 430.

For Next Month

Where Did the Indian Come From
All sorts of theories have been advanced to explain the origin of the American Indian—most of them complicated, improbable, contrary to known facts. The Indian's origin is comparatively simple. Dr. Ales Hrdlicka, famous Smithsonian Institution anthropologist, will tell about it.

Do You Plant Your Crops "in the Moon?"
Intelligent folks have always pooh-poohed the old-fashioned superstition of planting by the moon's phases. Now it begins to look as if there might be something in it. Professor Sheldon will tell you how to make some experiments with plants that may throw more light on the problem.

"The Most Amazing Psychic Case in History"
So Dr. Walter Franklin Prince, distinguished psychic research worker, characterizes Patience Worth. He describes the manner in which a St. Louis woman receives dictation of high literary merit from some mysterious source.

Other articles on Natural History for Tourists; New Methods on the Farm; The Atmosphere in Cross Section; Social Intelligence Tests; Welland Ship Canal; A Precision Balancing Machine; Measuring the Color of Hay; Radio.

MORE THAN 200 PICTURES

LODGE

CABLE despatches from across the water have indicated that the Royal Society of Great Britain has been asked by one or more of its members to consider the advisability of requesting Sir Oliver Lodge to resign from the Society on the ground that his views on spiritualism—or spiritism, to be more correct—are prejudicial to the interests of the Society. This attitude represents, surely, only a small minority among the members of the Society; for it is incredible that this great institution should assume the right of censorship upon all expression of personal views by its members on general scientific subjects. On the other hand, since Sir Oliver, because of his wonderful facility in writing down to the understanding of the general public, has such a widely extended vogue, we think that he should be careful to make it known that when he writes as a so-called spiritualist, he is giving merely his personal views, and that these views are not to be taken as an expression of the attitude and belief of the great Society to which he belongs.

SIMPLE?

AN editorial office would not be an editorial office if it were not for the chap on the staff who is always bringing up peculiar questions and starting arguments. Here is one of our latest questions: What is the greatest number that can be indicated by means of three digits? Having found an answer that satisfies us, we wonder whether some of our readers would not like to try this little problem. There is no "catch" in it, no trick; the regular methods of notation employed by mathematicians may be used.

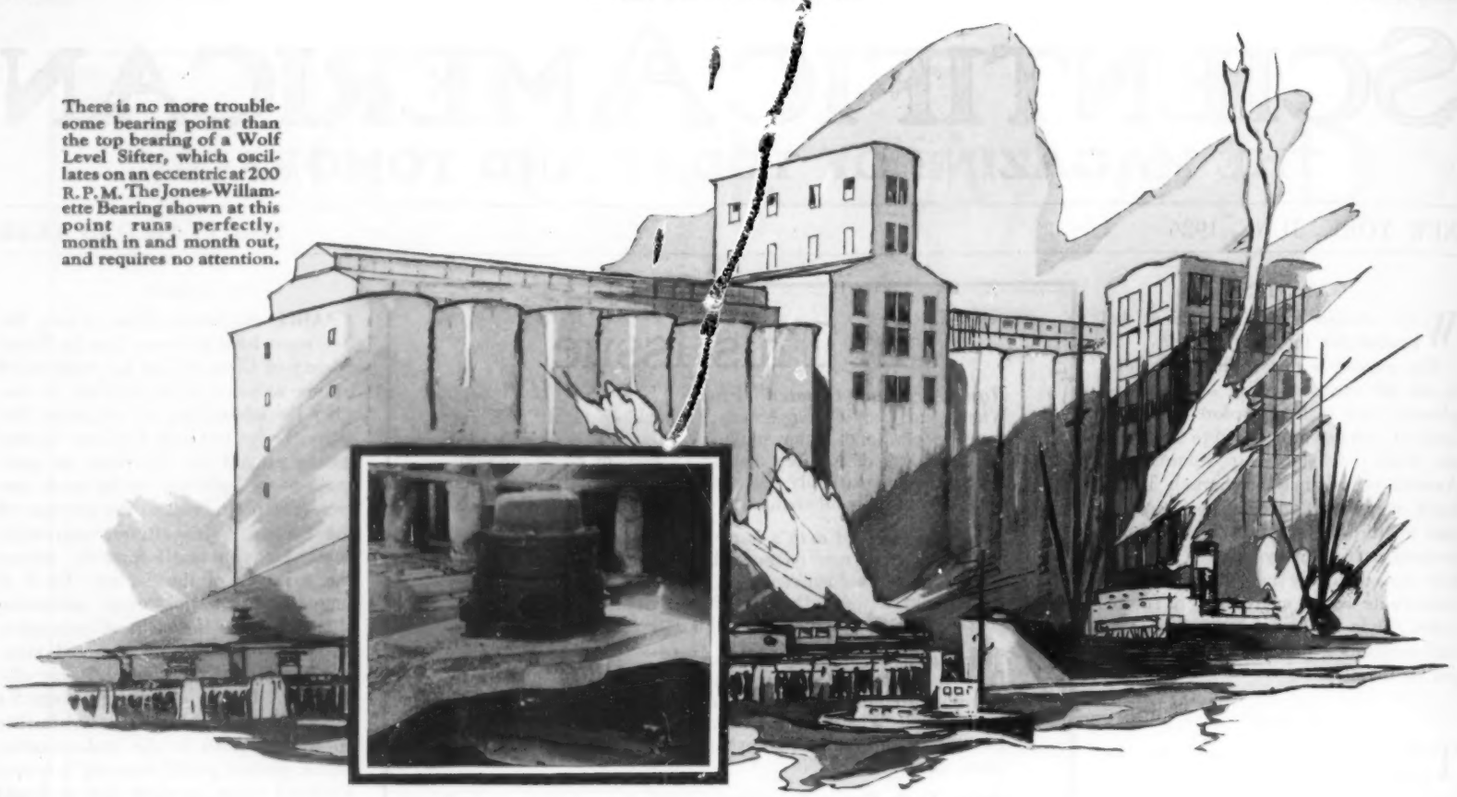
Next month we shall publish the answer. Perhaps in the meantime some of our readers will send in the correct one.

PROGRESS

BY July 1, the population of Continental United States will be 117,135,817, the Census Bureau estimates. This will be an increase of 11,426,197 since the last Federal enumeration in 1920.

A gain of a million and three quarters is recorded since last July.

Growth, yes. But does that mean progress? The report of another bureau—the Patent Office—may shed some light on that point. Commissioner Robertson states that last year 46,540 patents were issued, a gain of 3,986 over 1924 and the greatest number issued in the history of the country. All the signs point to a still higher record next year.

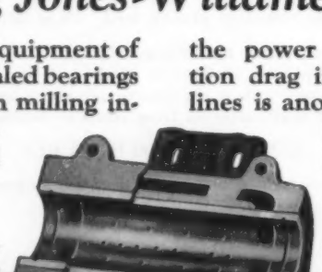


There is no more troublesome bearing point than the top bearing of a Wolf Level Sifter, which oscillates on an eccentric at 200 R. P. M. The Jones-Willamette Bearing shown at this point runs perfectly, month in and month out, and requires no attention.

Flour mills can eliminate costly shutdowns and oil damage to product *by installing Jones-Willamette Bearings*

There is no place where a full equipment of Jones-Willamette oil-tight, oil-sealed bearings is more important than in grain milling industry. Oil leakage into the product in process must be prevented or heavy losses ensue.

But the advantage of Jones-Willamette Bearings are not limited to this one feature. They eliminate costly shutdowns, due to bearing trouble. They cut the labor and attention mill machinery requires, put lubrication on a weekly or monthly instead of a daily basis, and consume only pints of oil where gallons have been used before. Furthermore, the power saving due to decreased friction drag in machinery and transmission lines is another important economy which follows Jones-Willamette installations.



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LESS FRICTION
LASTS LONGER

Action of shaft automatically filters and circulates oil to points of greatest load and friction. Complete lubrication means long life. Bearing is completely oil sealed—oil cannot escape nor water enter.

These bearings are now available in standard and special types to fit the requirements of every industry. If you are a user of bearings you should inform yourself regarding this development. One or two Jones-Willamette bearings installed in your plant will give you a new idea of bearing efficiency. . . . . Write for engineering data and descriptive literature.

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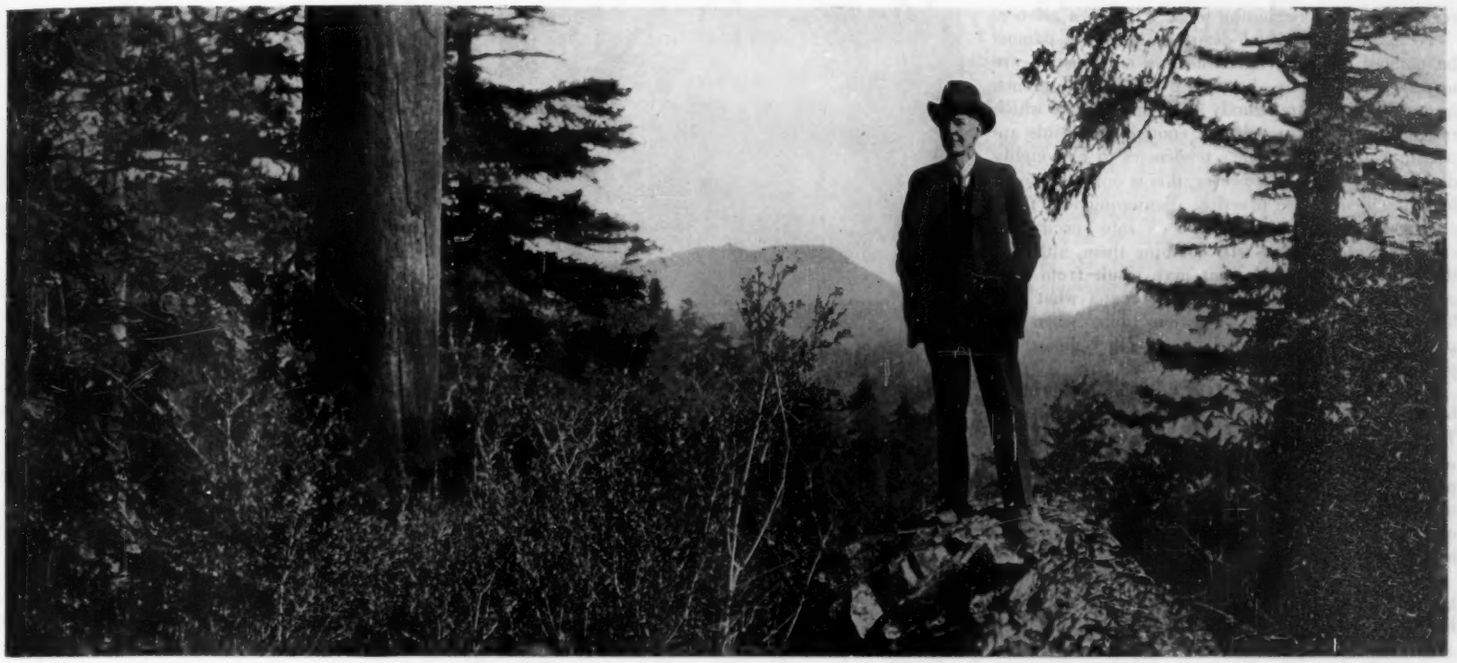


THE LATE LUTHER BURBANK IN THE VIRGIN FORESTS OF THE CALIFORNIA MOUNTAINS

Prodigal Mother Nature

By Cross-breeding and Persistent Selection the Plant Breeder Speeds Up Nature's Slow, Wasteful Hit-or-miss Methods of Producing New Species a Thousand-fold

By Luther Burbank

INTIMATELY observed over a long period, Mother Nature is revealed as a spendthrift and almost careless old lady, wasting and throwing her treasures about with the opulence of a mining man on a spree.

Every living thing under her care produces hundreds, thousands or even millions of the seed of its own kind—so many, as has often been remarked by scientists, that if any considerable share of them germinated, grew and developed, they would overcrowd the world with one species in a short period. Yet we know that Nature has a reason for everything she does, if we look far enough, and we are compelled to search here for the reason.

Whenever you dip into any of the sciences that are founded on or are akin to biology it is necessary to go back to the one master, Darwin. He found the reason, although he did not state it in so many words in this connection. His law of "the survival of the fittest" is the basis for an explanation of our puzzle.

Nature's Wastefulness Useful

Only the fittest survive, in the end, as long as we leave Mother Nature alone, or when we use intelligence and skill in assisting her; her prodigality, therefore, makes possible an almost infinite number of seeds, so that the death or what we might call the murder of the weak may occur again and again—hundreds of thousands of times in one generation—and after the massacre is over, there will still be a few strong individuals to carry on the line. The very fact that these survivors are the plucky and hardy ones of the family necessarily tends to improvement in the species.

There are two factors which have entered into the scheme of things to make this original and natural prodigality of Nature's seem, at first glance, unnecessary and even superfluous. Of course, she does not change to accommodate herself to new conditions—for she is unchanging in her laws—and we shall see presently that it is a good thing that she has not abandoned her prodigal ways, and that apparently wasteful production of seeds and seedlings are actually useful to man still. She was reckless in producing seeds because she could afford to be, with plenty of raw material in the plants and with plenty of time in which to work her gradual changes and developments in her children.

"Wizardry," or Taking Infinite Pains?

What was that magic by which the late Luther Burbank produced new kinds of fruit, new vegetables, new flowers? In the main, what Burbank did is what most of us might do if we would first make a profound study of Nature's ways. Yet, even should we do this, could we be sure of duplicating Burbank's successes? It is unlikely, for we are not Burbanks. This is only another way of saying that few of us exhibit that willingness to take pains that defines "genius," or the rare aptitude which Burbank had for making accurate observations and reasoning correctly from them. Perhaps, however, what we most lack is that elusive something which Mr. Burbank called "intuition." After all, then, was he not a kind of wizard?

The first of the new factors in the scheme were birds and insects. It is calculated that more than 240,000 new species of plants came almost suddenly into existence when bird life and insect life, especially the bees, were evolved. Birds and bees and other insects sought food, and in their busy scurrying from fruit to fruit and from flower to flower they carried pollen that caused crosses to begin to appear, crosses which resulted in the incidence of new species. I say almost suddenly, although of course, I mean that only relatively. Generally speaking, the development was very slow—by what Darwin called "slow variations." But, looking back down time from this distance, it was sudden. For the birds and bees accomplished in a hundred years, perhaps, what it would have taken Nature ten thousand years to do with her old careless, hit-or-miss fashion of using winds and floods and accidents to effect crosses.

Only Persistent Selection Brings Success

The second factor in speeding up Nature's processes and making her prodigality seem unnecessary was man. Plant breeding is a comparatively new science, but soon after man emerged from his primitive condition he accidentally brought about crosses by throwing strange heredities together, and by a selection that he was not conscious of, he developed better or different varieties. He knew no science of plant breeding. It is doubtful if he ever realized that he was by his own acts improving strains. Nevertheless, that is what he did do, so that new species were gradually created while the old wild parent-species were still to be found following Nature's methods and improving themselves by age-long processes.

Darwin believed that the formation of species came only through those slow variations mentioned above, but for some time now we have realized that there are comparatively swift and sudden methods of species-forming. In short, plant breeding has developed into a practice, and as we learn more and more about the underlying principles of the art, we

realize that it is beginning to be fixed as a science.

To make clear what I desire to set forth, it must be pointed out here that what we call species are merely aggregations—bundles of individual plants, no two of which are exactly alike but most of which resemble one another closely enough in outside appearance and in hereditary tendencies to be roughly divided into species. However, this is only an empirical classification we practice. Beginning with these aggregations of plants, divided off into species, we can effect crosses that will combine them, although it cannot be predicted what may result from such crossing any more than one can predict what will happen to the second-generation plant when the parent plants are subjected to any other disturbing pressure from without.

There are no rules yet laid down as to the combining of various hereditary characteristics in plants. The chemist can tell fairly accurately what will occur when he compounds two or more chemicals, but the plant breeder cannot. This is because there are ten thousand heredities bound up in one plant, instead of, as in chemicals, a one-track and changeless heredity.

However, we have discovered that there is a method by which, when another step is taken, the plant breeder can tell almost exactly what result he will get; not only that, but he can be the architect of this work. By taking this step, he can plan accurately and closely what he wants to build in plants and then he can carry out his plan with a well-nigh mathematical accuracy. That step is *persistent selection* in a given and very definite direction and with a definite aim never lost sight of nor abandoned.

More than "Book-learning" Needed

In the first generation after the cross-breeding of two heredities we generally find a more or less complete blending of all the characteristics of both parents, not only in outward and visible respects, but in the innumerable invisible ones that are inherent and that are certain to affect the plant, but that cannot be determined until growth has developed the plant and until selection and reselection has eventually fixed the characteristics which we desire. This might almost be called a fundamental educational process extending through successive generations, each of which is given a certain impression until those impressions have registered, almost as on a sensitive film, and become an ineradicable picture.

And so, after birds and insects had cut Nature's time down from ten thousand years to a hundred, man came along and cut the time required by birds and bees to a few years. He was able to do this, you will see, because the birds and the bees moved by instinct—and incidentally while actually engaged, as far as they themselves went, in getting food—while man has brought his intelligence to bear on the problem and now uses experience, study, experimentation, thought and definite work to aid him.

NEW SHRUBS IN THE MAKING

Selected individuals of ornamental shrubs being developed as new varieties by breeding and selection

I said above that plant breeding has developed into a practice and that it is beginning to formulate laws and formulas which bring it very close to a science. But the personal equation still enters too largely into plant breeding for rules to be laid down and a technique established that will enable anyone to study the subject in college and then go out and perform its miracles. The plant breeder, before making combinations, has to use the greatest care, based on a wide experience, to select the individual plants which seem best adapted to his purpose.

The differences in the individuals which the plant breeder has to work upon are sometimes extremely slight. The ordinary unpracticed person cannot by any possibility discover the exceedingly minute variations in form, size, color, fragrance, precocity and a thousand other characteristics which the practiced plant breeder perceives with one lightning glance. The work is hard and exacting, requiring an exceedingly keen perception of minute differences, great practice, and extreme care in treating the organisms operated upon. Even with all the naturally acquired variations added to those secured by scientific crossing and by numerous other means, the careful accumulation of slight individual differences through many generations is imperative. And after that several generations are usually necessary in order to "fix" the desired type for practical purposes.

It will be clear then that plant breeding is still only in the beginnings of its possibilities; selection is so nice and so delicate a task that the best of us must necessarily fail and blunder and miss great opportunities. It is this fact that leads us back again to the point from which we started. It brings us to Nature's prodigality, and what I wrote concerning the advantage to mankind that is still to be found in what appears casually to be a wasteful production of seeds and seedlings and new growths from old parent stems. For there have been countless instances in the experience of every plant breeder where he knows he must have missed new and valuable discoveries.

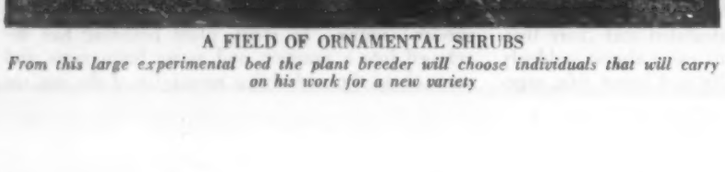
My development of the Burbank potato, many of my plums, and thousands of other productions have enabled me to be of service to mankind, but I have often thought:

"Among all the varieties that Nature so prodigally produces and sets before me for selection and experimentation, how many great gifts of hers to man have I missed?"

Many Variations Lost

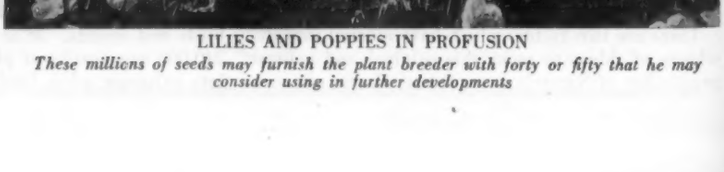
No doubt for every chance grasped there have been innumerable chances lost. It is so through all the history of plant breeding by selection. The Bartlett pear, the Baldwin apple, and the navel orange were all variations selected by some keen observer. But at the same time, think of the millions and millions of other variations that have passed unnoticed and have been lost to men and buried in oblivion forever for the lack of such an observer or because the observer passed them by!

For this our single consolation lies in the prodigality of Nature. She can produce almost without limit, and she continues to do so, and thus those variations we have missed, or others just as valuable to man, may recur and recur until they are caught and fixed. Our duty is to go on studying in her school and then, here and there, now and then, sometimes by intuition and sometimes by intention and sometimes by mere fortune or accident, we will continue to pick up from her treasures valuable varieties that will continue to make the world a better and a better place in which to live.



A FIELD OF ORNAMENTAL SHRUBS

From this large experimental bed the plant breeder will choose individuals that will carry on his work for a new variety



LILIES AND POPPIES IN PROFUSION

These millions of seeds may furnish the plant breeder with forty or fifty that he may consider using in further developments

How to Observe the Great, New Sun Spots

By Henry Norris Russell, Ph.D.

Professor of Astronomy at Princeton University. Research Associate of the Mt. Wilson Observatory of the Carnegie Institution

FOR the last year or two, the number of sun-spots has been rapidly increasing, and their size as well.

It is not an unusual occurrence now for a spot—or at least, a spot group—to be large enough to be seen with the unaided eye. "Unaided" is rather a misnomer, for no sane man would think of looking at the sun without some protective device, either the old-fashioned smoked glass or the more modern piece of densely fogged film. But, for the larger groups, no magnifying power is necessary. A good field-glass shows far more of the spots, provided that care is taken to hold the shade-glass directly in front of the eye, and not in front of the objective of the field-glass (in which case all its optical defects are correspondingly magnified). With this simple equipment, the amateur may see the spots and observe their stately progress across the sun's disk from day to day as the rotation carries them onward. He must be on his guard in one matter: as the diurnal motion of the heavens carries the sun across the sky, different points of its rim appear to be at the top.

Sun-spots are short-lived affairs and even the largest of them usually endure for only three or four months at best. Yet, although they are almost as short-lived as storms, they resemble storms in another way—they are far more likely to occur in some latitudes than in others.

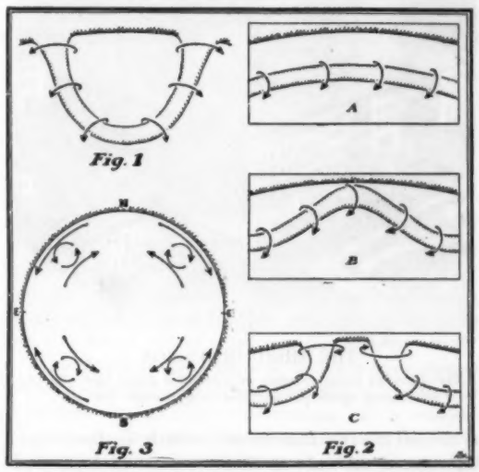
The Cycle of Sun Spots

Spots are hardly ever found more than 45 degrees from the sun's equator, and few of them are beyond the 35th parallel of solar latitude. Spots close to the equator are also rare—although not unprecedented. When, as at present, their numbers are increasing toward the maximum, they occur in two fairly sharply defined zones on each side of the equator, extending from about 15 degrees to 30 degrees of latitude, with a practically clear region nearly a quarter of a million miles wide, between them.

As the activity of the sun increases and new spots appear in increasing numbers to replace those which die out, the spotted zones widen, on the side toward the equator, until the vacant area between them becomes narrow. Then, after the maximum, the zones shrink on their outer edges, few or no new spots appearing in high altitudes to take the places of those which fade out. Finally, when the action has almost died down, the spots are practically confined to the region within 10 degrees of the sun's equator. Before the last traces of spot-activity have vanished here, spots belonging to the new cycle break out between 25 degrees and 30 degrees from the equator in new spot-zones, more than 400,000 miles apart. These zones widen as the number of spots increases, and so the cycle goes on. This remarkable behavior—known as "Spoerer's Law," after its discoverer—is of much importance, for it indicates clearly that the sun-spots are only symptoms of some deep-seated disturbance, involving a great portion of the sun.

There is plenty of other evidence now in favor of this belief. The work of Hale and his colleagues—which is too well known to need rehearsal here—has made it clear that the spots are vast ascending cyclonic storms on the sun's surface, in which the gases whirl upward and outward, in a direction exactly opposite to that of water running out of a wash-basin. The enforced expansion of the gases as they come to regions of lower pressure cools them, accounting for the darkness of the spots and many peculiarities of their spectra, while the gyratory motion, in some ways—still imperfectly understood—is connected with the production of the powerful magnetic field whose existence is detected by spectroscopic means.

Sun-spots usually appear in pairs, two large spots, lying almost east and west from one another, with sometimes a string of small attendants. In such a case, the leading and following spots—counting them in the direction of the sun's rotation—are practically always of different polarities, as shown by the magnetic effects, that is, the cyclonic whirls are in opposite directions—right or left-handed, as the case may be. In the northern hemisphere of the sun, and for years at a time, the leading spot shows almost always the same direction of rotation, and the following spot, the opposite one. Meanwhile, on the southern hemisphere, the direction of both whirls is reversed. This is not surprising, for in cyclonic storms on the earth, the direction of revolution is opposite on the northern and southern hemispheres. But a really remarkable thing happened in 1912, when the spots of one cycle were dying out near the solar equator. As soon as those of the new cycle appeared in high latitudes, it was found that the polarities were reversed and the directions of revolution for the preceding and following spots were just the opposite of what they had been before in the same hemisphere. Whether this was a general rule could not be tested until 1924, when still another cycle began. The reversal of polarity occurred again and it now appears highly probable that it is to be expected with each new cycle.



THE BJERKNES THEORY OF POLARITY CHANGE

The several phases of sun-spot phenomena depicted here are explained in the text of Professor Russell's article

This is not easy to understand. It is evident, as Hale has recognized since the first detection of the spot-vortices, that the two members of a "bipolar" pair must be connected in some way. The most obvious suggestion was that they are the two ends of a U-shaped vortex (much like that which may be produced by drawing an oar-blade through the water). Such a vortex is roughly illustrated in Figure 1, in which the arrows indicate the direction of rotation. It is obvious how, although the direction of rotation is really the same all along the deep-seated vortex, it appears to be opposite at the points where the two ends of the U-shaped whirl come to the surface.

This conception accounts very nicely for the bi-polar character of the typical group; but it does not fully explain why all such groups in a given hemisphere should rotate in the same direction. Moreover, it meets with another difficulty. There is a powerful flow of material out from the ascending funnel of the vortex at each end, sometimes for months continuously. Where does all this material come from, if the vortex is no longer than is indicated in the spectra? And why should spots vanish and break out again in nearly the same place?

These questions, and the more puzzling one of the change in polarity from one cycle to the next, appear to be well answered by a suggestion which has been recently made by the distinguished meteorologist, Bjerknes. According to this, the primary vortex to which a spot-pair is due lies ordinarily below the sun's surface and forms a ring extending clear around the sun, parallel to the equator. All along this vortex the material is evolving about its central line, just as the gases do in the familiar smoke-rings. Usually the whole affair is buried too deep to see, but at times it bends up and works out to the surface, as illustrated in Figure 2. When it does so, it produces a pair of spots, with their superficial rotation in opposite directions; but now, instead of having only a short strip of vortex between the spots to feed the escaping currents of gas, a huge vortex, extending all the way around the sun beneath the surface, is available and it may be that, before the spot-pair disappears, material which was originally hundreds of thousands of miles away may work out to the surface.

A New and Notable Advance

When the visible activity dies down, the severed ends of the vortex probably unite, leaving it still in existence under the surface, perhaps to gain energy and break out once more, in the same place or elsewhere. Wherever it does so, the polarities of the preceding and following spots will be the same as before.

But why should these reverse with a new sun-spot cycle? Bjerknes suggests that the still deeper-seated cause may be a slow drift of the material of the sun toward or away from its poles. Figure 3 is supposed to be a cross-section of the sun, with the poles at N and S, and the equator at EE. If there is a deep-seated drift toward the poles and a superficial one toward the equator, then, where one drift merges into the other, there will be a tendency for whirls to form, as indicated by the curved arrows—and these whirls are evidently exactly what a vortex-ring extending all around the sun would exhibit when cut in cross-section by a plane through the poles. There might be several of these vortices at different latitudes. All those in the northern hemisphere would rotate in the same direction, and when they broke out to the surface, would give spot-pairs of the same polarity, while the vortices in the southern hemisphere would rotate in the opposite direction. So long as the underlying drift at the surface continued toward the equator, this situation would last. If, however, this died out in time, and the poleward drift took its place (with a return drift towards the equator deep down) a new set of vortices would come into existence, every one of which would be reversed in its rotation, compared with those of the last cycle in the same hemisphere.

Although much, of course, remains to be done, this suggestion explains so much that was previously unaccountable that it may well be hailed as a notable advance in the interpretation of solar phenomena.

And We Call Ourselves Efficient!

By H. W. Slauson, M.E.

MAJOR ELIHU CHURCH, the transportation engineer of the Port of New York Authority, says that the principal costs of making a freight shipment consist in the expense of crating the goods for the journey and in trucking them to and from the railroad or steamship that carries them over long distances.

He tells of an importer in New York who purchased a considerable quantity of goods in, let us say, Hamburg. When received, they were loaded on trucks at the New York pier and carried four miles through the streets of Manhattan Island—one of the most progressive boroughs of one of the most progressive cities in the world—to the warehouse of the purchaser. When the freight and trucking bill was paid, it was found that the four-mile land transportation cost more than the three thousand miles of transatlantic shipment!

Multiply this loss of time and money consumed by traffic congestion by the number of consignments of all kinds of goods from other parts of this and foreign countries, and we can realize why he estimates that the loss to shippers and receivers of freight and express—which loss, of course, is passed on to you and to me, the ultimate consumer—approximates one-half million dollars a day in New York City alone.

Cost Measured by Time

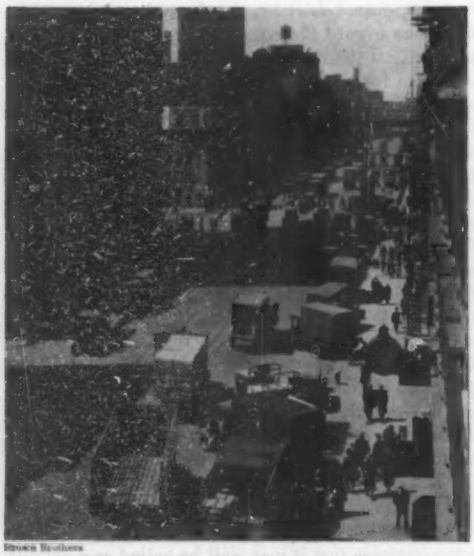
But New York is not necessarily any worse in this respect than others of our so-called thriving, hustling cities. We are merely citing this metropolis because it suffers from a combination of all the transportation ills which modern conditions of living and business congestion have brought upon other growing cities.

Of course, the city forefathers of New York, when they first laid out the comprehensive plan of highways and streets on the island of Manhattan, could not conceive that rail and motor transportation would convey all our traffic north and south, instead of toward the two waterfronts—which, in those days, represented the only available means of local and distant traffic. Consequently, streets leading toward the waterfront are about three times as frequent as those running north and south, which must constitute the main arteries of the island.

Drawn by Arthur T. Merrick

THE THIRD DIMENSION

Forty times as many tenants occupying a given site—but no additional space for vehicles to approach that site



Brown Brothers

ONE REASON FOR SLOW TRAFFIC

Rear-wheel-to-curb truck delivery congests traffic

The old saying that time is money was never so well illustrated as in the case of transportation delay. A motor truck is economical when it can work at high capacity, and at comparatively high speed. Cut down that speed to a crawl, and it represents no advantage over a horse, or even a push-cart for that matter. But insurance, drivers' wages, interest on investment and other items continue whether that truck is moving or standing still. The Major estimates that the minimum cost of such a truck is six cents per minute, whether traveling at zero, or at fifteen miles an hour, and declares that "the cost of trucking is measured by time, not distance."

This same engineer has also discovered that the average waiting time of each truck—motor-driven or horse-drawn—at piers and at other shipping terminals, is 68 minutes, including 14 minutes loading and unloading time. Furthermore, because of this waste of time, the average load carried is only one and one-half tons. Is it any wonder then that freight can be hauled by rail from New York to Buffalo for approximately the same cost as that of two or three miles delivery transportation charges to its warehouse or other consignment point in the city?

Automobile owners no longer go "pleasure riding" in the city. Every vehicle which we see on our streets represents a medium of transportation—usually necessary. Were it not for the private passenger cars, there would be a greater number of taxicabs. Were there fewer taxicabs, there might be more buses or trolley cars; and were there fewer vehicles of all kinds, our present volume of business transactions could not be conducted.

Naturally, the most efficient traffic is that which can move rapidly. Every stationary vehicle represents a direct impediment to efficient transportation; but as we have already intimated, every moving vehicle which we see has some definite destination in mind and it must reach this objective before it can return to its garage, or stable. The stationary or parked vehicle, therefore, represents the real problem in our traffic congestion situation, and could an Aladdin's lamp be devised which could immediately waft into the air or under ground every vehicle which has reached its temporary destination, we would have no traffic tangles or four-mile-an-hour trucking speeds.

Our Cities Are Cubes

"A place for every stationary vehicle" should be the slogan of every modern city. We have enacted building laws which limit the height of structures under certain conditions of area and location. We have conceived great plans for elevated express roadways, vehicular tunnels and pedestrian bridges and underpasses. But these are expensive remedies, they do not provide for the maximum needs of any locality, and they furnish but scant solution to the problem of the stationary vehicle.

We must go directly to the source of this difficulty to find its solution. What has produced our traffic problem? It is the *concentration* of business and living. Our cities are no longer planes, having but two dimensions; they are *cubes*. We have entered the third dimension with a vengeance in our business and city dwellings, and yet we expect the same two-dimension highways to take care of our moving and stationary traffic.

Let us consider a concrete example. You have moved into a fine new office building of which you are justly proud. It may occupy a half or a full city block—say a block 200 feet square. It occupies

Brown Brothers

A BRIDGE FOR PEDESTRIANS

The space beneath is free for vehicular traffic

a street on which once stood 30 or 40 brownstone dwellings each housing a typical American family, or probably a total of 150 persons for that block. But in your office building, occupying exactly this same space, there may be 5,000 fellow tenants and office workers. You and they must go daily to and from this building. You are all engaged in business of some sort, and your customers must come and go. You must be supplied with office necessities, goods to sell, and with heat and food. Therefore, the traffic made absolutely necessary by that building facing on 800 feet of street space would supply a village of three or four thousand inhabitants; *but there is not one foot more of curbstone or parking space to meet these supply requirements than was the case in the brownstone front days when each family was supplied with 20 or 30 feet of sidewalks in front of its own private property!*

City Planners Lacked Foresight

On all four sides of this building the same conditions either have already been reproduced, or will be in the near future, if our present urban viewpoint continues. Our City Planning Commissions, for the most part, have been sadly lax in foreseeing these conditions. They have permitted the erection of veritable hives of apartment dwellers and office workers, but have made no provision for compelling the solution of the traffic and transportation problem which these new building conditions create. True, some modern buildings have been constructed with street-level arcades cut under the building to furnish vehicular space to what would normally be the building line, and to provide pedestrian space actually within the building proper.

As a supplement to this system however, we should provide parking facilities for every vehicle brought to that vicinity by the increased requirements of the building occupying the space in question. In designing a modern building, the architect devotes a certain percentage of its otherwise available rental space for the vertical transportation of its tenants in the form of stairways, elevator shafts, and fire escapes. But he must do more. The owner of a modern building should be glad to devote at least five percent of its profitable space to the temporay storage of the vehicles which the business or social activity of the occupants of that building brings to its immediate vicinity.

What would we think of a railroad which undertook to serve a thriving city and yet did not provide freight yards, passenger depots and other facilities to care for the temporarily stationary traffic? We would tell that railroad that it must buy land and provide space in which the contents of passenger and freight trains could be discharged, or taken on, without interfering seriously with the remainder of the traffic service which that corporation was supposed to furnish.

We cannot well redesign our cities, and distribute centers of business activity over a larger area. Business of one kind gravitates to a certain section and concentrates there. We have already stated that this growth can only be upward to the third dimension, and that the solution for this parking problem must also be found within this same dimension.

This required parking and delivery area cannot well be obtained from open space which is otherwise available for building construction. It is nonproductive of revenue in the same manner as hallways and stairs offer no rental return. Also the ground floor of any building is, as a rule, its most valuable portion. But present-day buildings are constructed with three, four, five and even six cellars or subbasements in which fuel and other supplies are stored, and in which the necessary machinery for the operation and upkeep of the building is located.

The first of these otherwise nonproductive subcellars could be connected with the street by means of a wide ramp, or sloping roadway, as is typical of modern garage construction. In the sub-cellar thus made available, could be stored all cars and other vehicles, the owners or drivers of which have occasion to transact business within the building in question beyond a certain definite time, such as one-half hour. In this sub-cellar also all deliveries for the building in question could be made, and easy connection with the freight elevators obtained.

One of the most serious impediments to modern traffic in our average city is the long wheelbase truck which is backed to the curb and which overhangs partially across the sidewalk, for the purpose of street-level delivery to these improperly constructed buildings. With street space so valuable, and with traffic congestion so serious, in case of a severe fire in such a congested area, this practice of rear-wheel-to-curb truck delivery should never be permitted.

Would This Plan Be Feasible?

Such a plan would, of course, add somewhat to the cost of building construction and maintenance. It could, however, be assessed partially against the tenants who made use of such a service which would keep their cars under observation, protected from bad weather, and available at any moment. This personal convenience, however, is not the primary object of this plan, and its light cost is borne by the tremendous saving which would follow through the increased speed of traffic and the restoration of city streets to their original purpose of highways for *moving* traffic.

It should, of course, be understood that such a plan is recommended only as a part of the zoning laws of our various cities, and that it is to apply only to such buildings whose height, size, and nature of use create a large amount of vehicular traffic in their vicinity. It might not, for example, need to be applied to buildings under ten stories in height, and certainly not to those public institutions surrounded by parks, plazas, and other space providing adequate parking area.

For department stores, hotels, and office buildings, in areas of narrow streets and congested traffic, however, the solution of this parking problem within the building itself—the creator of that congestion—is of vital importance to the safety, utility, and efficiency of our transportation system, not only of the future but of the immediate present. And it is upon transportation that our living, enjoyment, and efficiency largely depend.

A Problem That Needs Solving

Every man, woman and child in every large city in the country is paying approximately two hundred and fifty dollars a year that would not have to be paid if freight were handled efficiently.

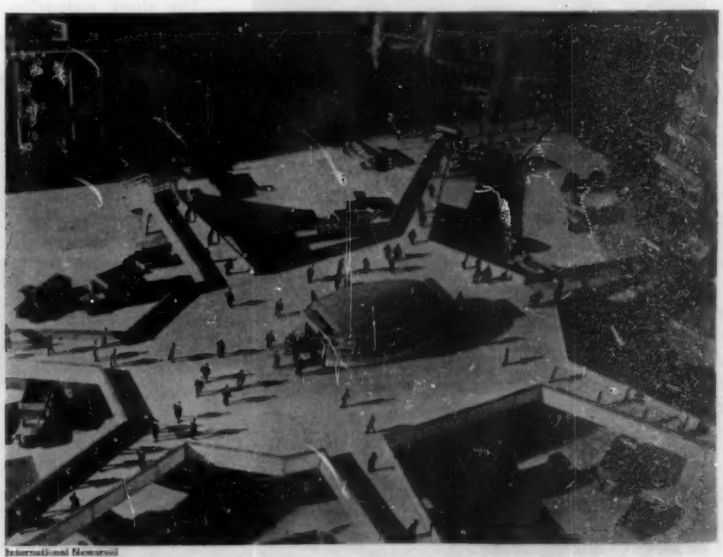
The street traffic muddle is the one outstanding problem facing city plan engineers. Building laws have been passed to limit structures to certain heights, areas and locations. Elevated and subway tracks, vehicular tunnels and pedestrian bridges and underpasses have been devised. All of these together, however, will not suffice. Our business and living quarters are becoming more and more congested, more and more motor cars are crowding our streets, and more streets are impossible.

Mr. Slauson makes an interesting proposal. Will it prove a solution? At any rate it is worth consideration.

© Edwin Levick

CONGESTION ALONG THE LOWER HUDSON RIVER

When one visits the docks of steamship companies along New York harbor, one has some realization of the vast amount of domestic and foreign goods which must be carried away



International Newsreel

THE "SPIDER" MAY SOLVE BERLIN'S TRAFFIC PROBLEM

Dr. Malberg, official architect of Berlin, has made a model of a traffic plan which consists of a platform elevated over the street level. In the center is the entrance to the subway

The Internal Heat of the Earth

The Center of the Earth—What We Know of Its Temperature, Structure and Its Composition

By Frank Wigglesworth Clarke
Chief Chemist, United States Geological Survey, Retired

THAT there are high temperatures within the earth has been known since the beginning of civilization. The testimony of active volcanoes was definite and conclusive. To mediaeval philosophers volcanoes were the chimneys of hell, which, as everybody knew, was situated somewhere beneath us; and streams of molten lava proved it to be a fit abode for heretics and other less dangerous sinners.

Hot springs gave similar, but much milder information. What could be clearer or more satisfactory? There may have been other attempts to explain volcanic phenomena, but if so, all were qualitative. The evidence on which to base quantitative explanations was yet to be discovered. How hot is the interior of the earth, and how is the heat distributed? To answer these questions many lines of evidence now converge.

Theory Run Rampant

The simplest line of attack upon the problem before us is found in the study of deep mines and wells in which the temperature gradually rises as we descend. The rate of increase is not the same for all localities, but ordinarily ranges from one degree, Fahrenheit, in every 50 or 60 feet of depth. The deepest bore hole yet driven is only about a mile and a half deep. From this it is a long journey to the center of the earth, nearly 4,000 miles away.

Nevertheless, attempts have been made to take that journey mentally, and curious results have been reached. By various methods of extrapolation, all of them based upon the assumption that the observed increases of temperature continue to the center of the earth, temperatures have been computed for the latter point in many thousands of degrees, so many that the temperature of the centrosphere should exceed the critical temperatures of all known elements which, if not actually decomposed, would form a vast pseudo-gaseous mass quite unlike anything of which we have any real knowledge. The temperature of the sun would be exceeded many times, a conclusion which seems very much like a *reductio ad absurdum*. This line of attack upon our problem needs no further consideration.

Is the Earth's Interior Molten?

Man has never been able to penetrate much more than one mile beneath the earth's surface—a mere pinprick. Yet, while science does not claim positive assurance regarding the actual conditions in the earth's inner layers, there are certain things about it which we know are not so. One is that the earth's interior is a molten liquid. Probably nothing has tended so strongly to crystallize this widespread misconception as the existence of volcanoes, pouring out liquid lava. In the earth's center, however, the pressure is too great for the rocks to melt. Thus, they are as rigid as steel. The seismologist can easily prove the latter statement, for he records earthquake shocks that travel through the earth's interior; and it is the characteristics of these shocks that prove the earth's interior to be rigid. Volcanoes are held by the majority to be of local, not deep-seated origin.

In order to reach any definite conclusions relative to the heat within the earth we must begin by considering the earth itself as a whole. Its dimensions are well known, its mass has been determined, its mean density established, and its rigidity shown to be at least equal to that of steel. It is a solid body, it behaves like a huge magnet, and in many respects it resembles an enormous meteorite.

Meteorites fall into two principal classes, those consisting mainly of an alloy of iron and nickel, the other mainly of stone. Between these classes there are many intermediate forms, irons enclosing stony matter, and stones containing more or less iron.

The stony meteorites are composed of minerals such as are found in igneous rocks, and which, being crystalline, must have solidified from a state of fusion. The irons also, as shown by their peculiar crystalline structure, must have originated in the same way. It is now generally believed that meteorites are fragments of a body of sub-planetary dimensions, although the cause of its disruption is unknown. The close similarity between the broken planetoid and the earth seems to be very clear.

The mean density of the earth is about 5.5 or a little higher. That of the igneous rocks in the accessible portions of the crust is not far from 2.75. That is, the earth as a whole is twice as heavy as it would be were it composed of substances such as form its crust. To account for the difference, there must be heavier substances within it, presumably metallic, and mainly, in all probability, of nickel-iron. The outcrop of iron in basalt near Ovifak in Greenland resembles meteoric iron in all essential respects, although it is clearly terrestrial. Is it a sample of the centrosphere, the nucleus of the earth, left stranded when our planet cooled?

A Core of Solid Metal

That the earth was once a molten mass is generally admitted by geologists and geodesists. Its outermost shell, except for a thin layer of sedimentaries, is composed of igneous rocks, granitic near the surface, and shading off into heavier ferromagnesian rocks beneath them. For present purposes the ocean and the atmosphere can be ignored. Their influence upon the mean density of the earth is insignificant. The centrosphere, as suggested in the preceding paragraph, is a heavy, metallic, rather irregular spheroid of density not far from 7.8. These conclusions are supported by a great mass of evidence, which can only be briefly summarized. They bear upon the problem of internal temperatures.

In the cooling globe the nickel-iron separated from its rocky envelope, just as iron does from slag in a blast furnace. The separation was not perfect,

Courtesy of the Department of the Interior

GIANT GEYSER, YELLOWSTONE PARK
Geysers are doubtless of relatively superficial origin

Brown Brothers

LAVA FLOWS, MT. KILAUEA, HAWAII
Their temperature is only about 1,800 degrees

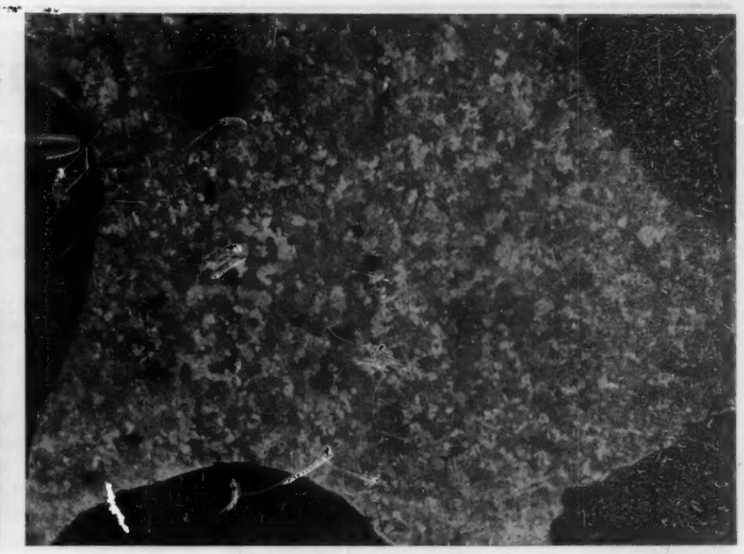
Haynes Photo

"OLD FAITHFUL," YELLOWSTONE PARK
When the pressure is lowered, the water flies into steam

Courtesy of the American Museum of Natural History

THE LONG ISLAND METEORITE

It is the largest aerolite or stone meteorite known, all the fragments aggregating 1,325 pounds. It consists essentially of a kind of pyroxene, olivine and chromite



THE WILLAMETTE METEORITE

This meteorite fell in Oregon. A section has been polished to show the Widmanstatten lines of the metal. This is a siderite, consisting essentially of nickel and iron

of course, but very nearly so. The nucleus of the earth would contain stony inclusions, like meteoric iron, and some iron would remain entangled in the rock. By two distinct methods the relative volume and masses of centrosphere and lithosphere can be estimated, and values having a high degree of probability can be obtained. Weichert, from a study of earthquake waves, found that the centrosphere and lithosphere are very nearly, if not quite, of equal volume. From the relative densities of the same components we can compute the proportions needed to give the mean density of the earth, and the equality of volumes is confirmed. The two methods lead to the same conclusions, and the margin of error is not large.

It is not necessary here to go into details of the computations. According to Weichert the diameter of the metallic nucleus or centrosphere is of the order of 10,000 kilometers or 6,214 miles, to which a thickness of its rocky envelope of 855 miles corresponds. The figures deduced from the densities are 6,192 miles for the nucleus and 863 miles for its envelope. A better agreement could hardly be expected.

Old Heat and New

Now, with some notion as to the internal structure of the earth, we are in a position to discuss the distribution of heat within it. That heat may be considered under two headings; first, the residual, or original, heat retained by the cooling globe, and second, the new heat which is being continually generated in the outer zones of the lithosphere. This distinction is perfectly clear, although it seems to have been commonly neglected heretofore. What are the sources of the new heat? The question is fundamental.

Three principal sources of new heat in the crust of the earth are easily recognized; namely, friction, chemical reactions and radioactivity. The possibility that there may be other sources may be left out of account. That friction is an important source of heat within the lithosphere is evident. The crust of the earth, to a depth of many miles is in constant motion, and every tremor generates heat. Mountains are lifted up, strata are broken, bent, folded, or distorted; there are landslides and erosions, and earthquakes, great or small, are frequent; and everyone of these movements is a source of new heat.

Volcanic activity, which appears as a rule along lines of weakness in the crust of the earth, is commonly associated with earthquakes. Part of it, however, is due to chemical reactions, such as the combustion of heated hydrogen when it comes in contact with air. This heat, so far as it is generated during an eruption, is lost by diffusion into the atmosphere.

Volcanism, however, is not a very deep-seated phenomenon; the seat of its activity is less than ten miles, perhaps not more than five, below the surface of the earth. Volcanic temperatures, furthermore, are not extremely high. At Kilauea the temperature of the lava pool is only about 1,000° C. (1,832 degrees, Fahrenheit). Even if this figure is exceptionally low, all the evidence now available indicates that volcanic temperatures do not exceed 1,600° C. (2,912 degrees, Fahrenheit).

Apart from volcanism, chemical activity in the crust of the earth is manifested in many ways. Igneous rocks are altered into metamorphic forms, and new minerals are produced, each one the result of chemical reactions. Olivine is altered into serpentine, hornblende into talc, beds of pyrite into limonite, and feldspar into kaolin. Each of these reactions has thermal significance, whose magnitude we cannot yet determine.

THE EARTH IN CROSS-SECTION

The crust is relatively thin. Beneath it are heavier rocks. Contrary to popular belief, the earth's center is not molten

Chemical activity, however, is probably not deep-seated, but is limited to that part of the crust which can be reached by the three great reagents, namely, water, air and carbon dioxide. The deeper layers of the lithosphere are probably anhydrous.

Many, perhaps all, of the igneous rocks are radioactive, and radioactivity generates heat. According to some authorities, especially Professor Joly, this source of heat is large enough to account for all the heat in the lithosphere; but, it seems to me, that is not yet completely proved. The distribution of radium in the igneous rocks needs to be studied.

Taken altogether, the three sources of new heat are certainly adequate to cover the entire field: deep wells, hot springs, active volcanoes, and heated rocks.

But are they operative below the zone of isostasy? In that zone the continually shifting pressures must generate heat by friction; but below it, that is, below a depth of 60 miles, we have no positive knowledge. In the depths of the lithosphere the heat is probably all residual—which remains to be proved.

Earth's Core Not Very Hot

With the evidence before us, what conclusion can now be reached as to the internal heat of the earth? The earth appears to be solid and rigid, with a nucleus or centrosphere which consists chiefly of nickel-iron, of something like 3,000 miles radius. That nucleus is a good conductor of heat, and it is practically insulated by an envelope of igneous rocks, more than 800 miles thick, which is a much poorer conductor. Under such conditions the heat of the nucleus must be uniformly distributed, and the temperature, from margin to center must be the same, and probably lower than the melting point of iron or 1,600° Centigrade (about 2,900 degrees, Fahrenheit). It is probably much lower.

As for the rocky envelope, it is difficult to see how its temperature could be any higher. The thermal equilibrium is probably complete. From the center of the earth to the zone of isostasy, changes of temperature are probably very slight. Above it, in the region of new heat, there are continued fluctuations.

¶ *Dr. Clarke, the noted geochemist who prepared the interesting article you have just read, has devoted many years to a study of meteorites. In an early issue we hope to present his conclusions concerning the nature of these peculiar bodies.*

Our Point of View

To Make Our Libraries Efficient

A GREAT library—and a small one for that matter—can never be thoroughly efficient, that is to say, its stores of information cannot be readily available to the public unless it is in the hands of an expert librarian and a well-trained staff. Many of our greatest libraries are suffering today from the lack of such a staff. The growth in the size of these institutions and in the number of readers has been such, that, in many cases, they have outstripped the ability of the library staff to render effective service. Very largely the present conditions are to be attributed to the low rate of pay in proportion to the responsibilities and work entailed, for it is notorious that, since the war, the pay of librarians has not been increased proportionally to that of workers in other professional lines.

A noble building, housing a vast library complete with every modern appliance, will miss the great object of its existence unless the stores of knowledge contained between the covers of its books are readily accessible to the public. Today, in too many of the libraries the delay in obtaining some special book is apt to be lengthy to the point of exasperation, and too often the applicant has to be turned away, because the desired work is buried in the ever-accumulating mass of books.

Because of the existing conditions, all who frequent our libraries will be rejoiced to learn that the Carnegie Corporation of New York has set aside four million dollars for library purposes—the sum to be payable over a ten-year period. One million will endow a graduate school of librarianship in some great university; another million will provide an annual income which will be used to aid other library schools; a third million is for general endowment of the American Library Association—the income to be used in promoting the extension and development of library service; the fourth million is for carrying on the general activities of this Association and in aiding library schools until the three million endowment, in cumulating capital grants, is completed. Under the administration of the American Library Association, this sum of four million dollars should go far—not merely in improving the personnel of our great libraries, but in developing intensively the small library service.

Arbor Day and Tree Planting

ARBOR DAY is the American counterpart of an ancient custom. History teaches us that it was the practice among the early peoples to plant sacred groves and memorial trees and lay out shaded academic walks and stately avenues. Arbor Day, however, is of purely American origin and grew out of the conditions peculiar to the great plains of the west which were practically treeless over a large part of their area. To Nebraska belongs the credit for the initiation of the Arbor Day movement, when at a meeting of the State Board of Agriculture of that state, a resolution was adopted to set apart Wednesday, the tenth day of April, 1872, as a day to be consecrated to tree-planting in the state of Nebraska, and to be known as Arbor Day.

The movement thus initiated proved to be healthy and lasting, but its widespread success and its continuity were assured when it was recognized how strongly this movement would appeal to the children of the country. As a school festival, the observance of Arbor Day has spread not only throughout the United States but far beyond its borders. It is now in vogue in all the dependencies of the United States and in Great Britain, Canada, Australia, South Africa, France, Norway, Russia, Japan and China. The time of the observance of Arbor Day varies in different states and countries and is determined somewhat by climatic conditions. In general, the date is early in the year in the south and is set in the late spring in the more northern states. Over half of the states have enacted a law for its observance, and in two of the states—Nebraska and Rhode Island, it has been made a public holiday.

But the work of the schools is only a part of the widespread efforts to repair the damage which has been done to our once magnificent and far-flung forests. One of the most encouraging signs for the future is the growing realization by the lumber interests of the importance of forest conservation. The National Lumber Manufacturers Association which is pressing the point of view of the forest industries recently gave $100,000 to the Yale School of Forestry. On the other hand, although these efforts are encouraging, we must remember that a vast amount of work has yet to be done before the people of the United States and their Government can claim that they have taken hold of this great problem on a scale proportionate to its magnitude.

Luther Burbank

In the death of Luther Burbank, the world has lost one of its greatest benefactors and the United States one of its most noted citizens. There is a bond of very real sentiment between an editor and his "earliest subscribers," and Mr. Burbank was one of these. In his last letter (February 24th), he wrote, "Sixty years ago I took the Scientific American," and he maintained his touch with us to the end. The article on another page of this issue must have been one of the last efforts of his amazingly active life.

Typically American is the life story of this son of a New England farmer, who, with no other capital than his keen intelligence and astonishing capacity for work, rose to be one of the world's most famous naturalists and without a rival in his own chosen field of controlled evolution. The work of this great experimentalist in the plant world remains as a lasting benefaction to the race. His improvement of the staple foods of mankind is his finest monument—a monument draped, as it will ever be, by the exquisite blooms that were the offspring of his rich fancy and unremitting care. The simple epitaph on Wren's tomb in St. Paul's Cathedral may well be applied to Luther Burbank: "If you are seeking my monument, look around."

Norman Keep or Gothic Cathedral

ONE of the biggest problems confronting the architect today is that of developing the style of architecture which is best suited to the exaggerated height of the modern office building. Those of us who have grown up with these structures and have found something intriguing in their architectural treatment, will remember the successive steps by which the tall building has developed from a rigid and monotonous structure to the noble designs of the present day.

The first tall buildings were frequently likened to a huge elongated packing case, on whose four sides the windows were arranged in a monotonous checkerboard fashion. In the first period of development, an effort was made to break up these ugly surfaces by running across them at intervals heavy bands of cornice-like moldings, only to discover that the building now looked like a series of packing cases imposed one upon another. Some twenty years ago, we stated that since the modern office building was in effect, if not by intention, a tower, it would be best to accept the situation by emphasizing the vertical lines of the building. Shortly thereafter, several designs appeared which treated the building as though it were a Brobdingnagian classical column—a few of the lower stories being treated elaborately as a base, followed by a dozen stories of plain design, and surmounted by something answering to the capital of a column. Then came the Gothic influence, of which the Woolworth Building is of course the most notable, as it is the most successful example.

The final and most satisfactory tall building architecture is the result of accident—the accident consisting in the passing of a zoning law which required that the upper stories of tall buildings should recede in a succession of steps to permit sufficient light to fall on the streets below. No sooner had two or three of these buildings gone up than everybody, architect and layman alike, realized that here was a fine solution of the problem. Thus was born what we have called the Norman Keep style as against the Gothic style which it has supplanted.

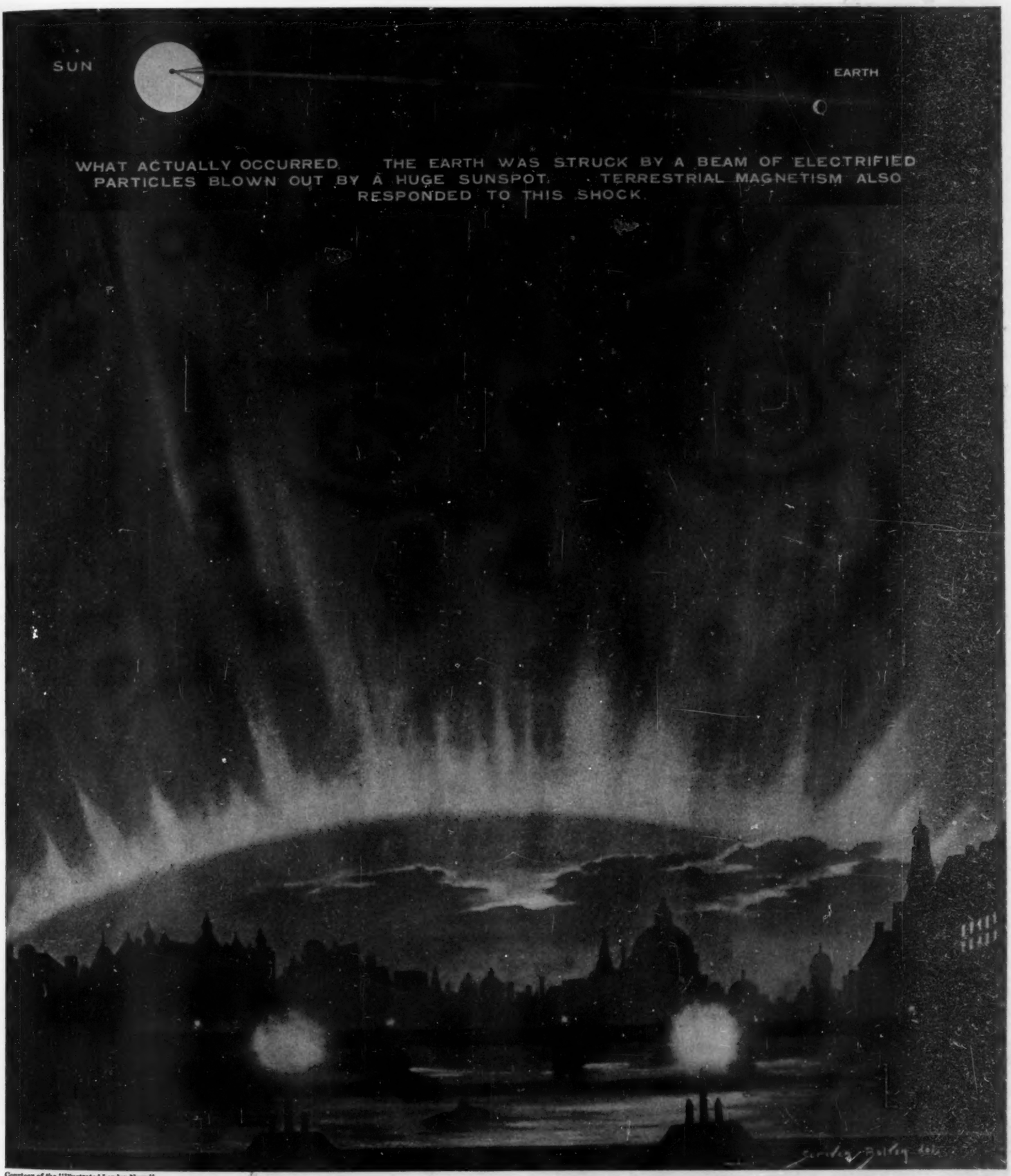
If you wish to realize the truth of this distinction, cross the Hudson River by ferry and look at the cathedral-like Woolworth Building and the medieval, Norman-type Telephone and Telegraph Building, and you will see at a glance that the palm for impressivness and beauty (we use the word advisedly) is carried off by the last-named structure.

Greatest Economic Factor in America

SURELY it is not stretching a point too far to say that the automobile is the greatest economical factor in modern American life. If you doubt it, we ask you to remember that the automobile bill of the American people is over 14 billion dollars a year—at least, so says a report by the Bureau of Industrial Technology; and they surely ought to know.

Our annual investment in automobiles is greater than the annual value of farm crops and over twice the annual investment in new buildings; hence, the automotive industry has risen to the position of the leading industry of the United States. This startling fact should not surprise us when we learn that the last annual registration of automobiles was about 20 millions; that the average automobile owner spends over $700 a year on his car; and that if each man, woman and child in the country were helping to pay the bill (and by the way, they are doing so indirectly) the annual expenditure per capita would be $117.

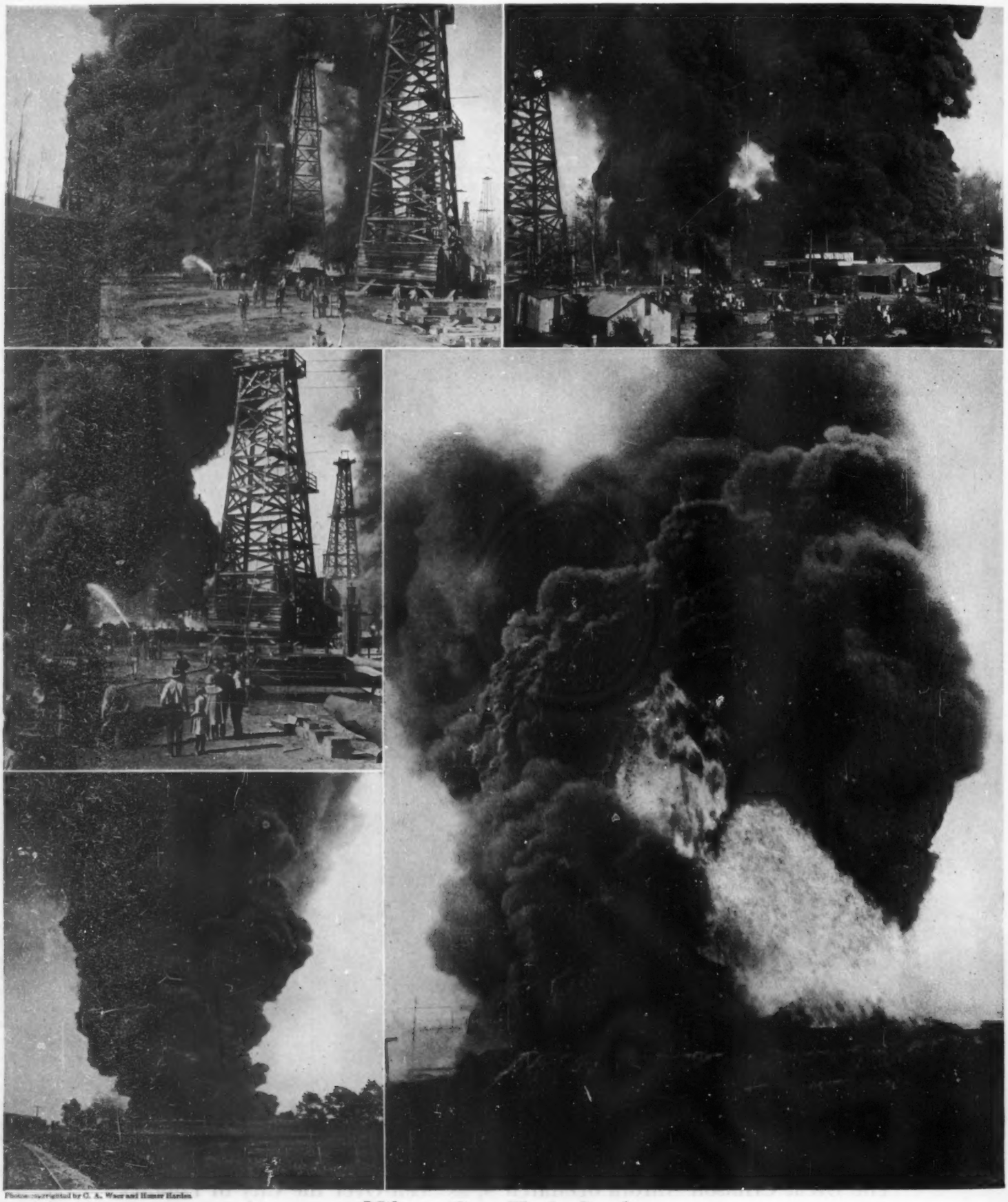
Not only is the industry stupendous in itself but its effects on other industries is in proportion. In road building, for example, where the programme now in the course of execution calls for the expenditure of about one billion dollars a year, and in the upbuilding of suburban communities where the new construction, in the case of many cities, is larger than that in the urban district itself.



Courtesy of the "Illustrated London News"

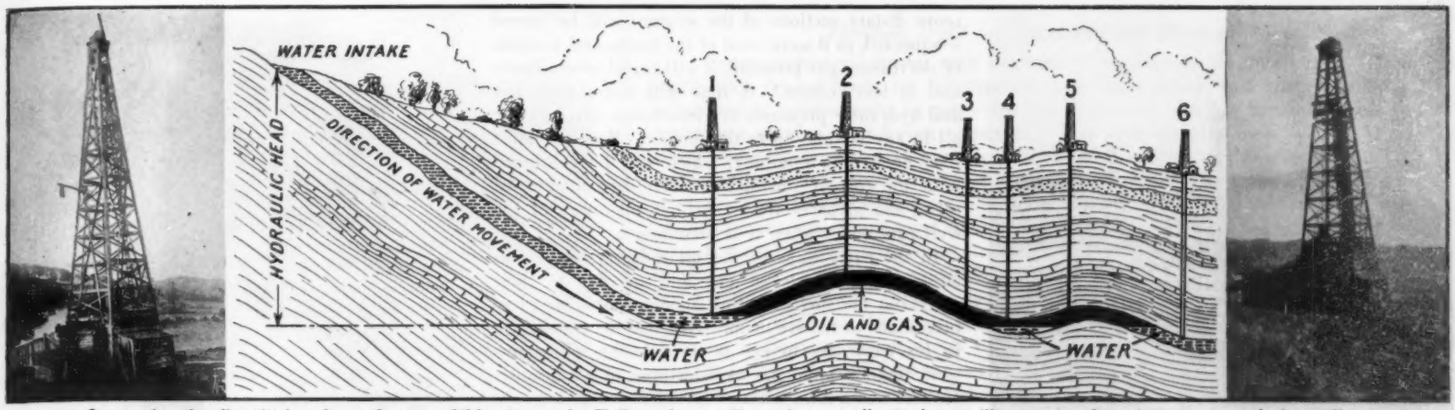
The Great Crimson Aurora of March 9, as Seen Over the City of London

An auroral display of greater magnitude and beauty than any seen in fifty years was observed in England early last March. One observer states, that immediately after eight o'clock in the evening the pink coloration of the streamers became very strong, changing to dark but intensely luminous red. Auroras are caused when electrified particles shot from the sun strike the earth's upper atmosphere. Professor McLennan of Toronto University recently demonstrated that an aurora could be artificially produced by shooting cathode rays through an exhausted tube containing 25 parts of helium to one part of oxygen. Thus, we discover, indirectly, the composition of the upper atmosphere. The height of an aurora varies from 40 to 600 miles.



Mileage Goes Up in Smoke

Oil losses in the United States are not as large as might be expected. In 1923 the loss from fire in derricks, refineries and pipe lines was $3,136,885; while in tanks or open pits it was $2,768,478. Not large compared with other risks. Two upper and middle pictures show oil field fire at Santa Fe Springs, California; damage $300,000. Large illustration shows a Texas well; fire caused by lightning. The lower left-hand picture shows an oil tank in flames.



LEFT: *An oil well 7,400 feet deep.* CENTER: *Oil-bearing sand. Well number 2 will get the most oil; number 6 will get none. One of many non-producing wells*

Uncle Sam, Spendthrift—II

Shall the "Wildcatter" Wreck Our Oil Resources as the Lumberman Has Wrecked Our Forests?

By J. Bernard Walker

IF Nature was generous in clothing the terrain of the United States with magnificent forests, she was even more lavish in providing vast resources of oil beneath its surface. If the surveys of the geologists, so far as they have gone, can be relied upon, and we think they may, the oil fields of the United States, developed and undeveloped, are the richest in the world. We have squandered the rich patrimony of our forests until, after three centuries of occupancy of the land, only five-sixths of those forests are left to us. Are we following the same spendthrift policy in regard to our wealth of oil? There is grave reason to fear that we are.

To any one who dispassionately reads the story of the brief 66 years of life of the oil industry, it might look as though the slogan of the men concerned in it has been, "Grab; grab quickly; and grab all you can."

Be it known that this statement is not to be taken as an unqualified criticism of the oil industry. The policy of getting the oil out of the ground as quickly as possible was rendered necessary by physical conditions over which the industry had no control. Unlike coal, oil is fluid; its recovery is on the principle of "first come, first served." The oil below one man's land may be drained by a neighbor's well. Hence the urge to grab quickly, and grab all you can.

Supply Is Not Inexhaustible

What has been the result of this policy? We read in a recent report of the American Petroleum Institute that "each decade since the beginning of the oil industry in 1859 has seen a volume of production equal to the total production throughout the whole previous history of the industry. During the years 1916 to 1925, more oil has been produced in the United States than during the whole previous period from 1859 to 1916." That is to say, we have taken out of our oil resources in nine years more oil than we did in the whole 57 years preceding. This being the case, the advocates of conservation will naturally ask themselves, how long will it take to bring our oil resources to the same lamentable state of depletion as our forests? We frankly admit, after a rather lengthy investigation of the subject, that this is a question more easy to ask than to answer.

We regard it as unfortunate that many of the able leaders in the oil industry (see the report of the Petroleum Institute) seem to think that Nature has stored oil in such unbelievable abundance that it simply can never be exhausted. On the other hand, the hearings before the President's Conservation Board proved that there are men of foresight and broad vision, possessed with a deep concern for the country's future, who not only believe that there is a measurable limit to the amount of oil in the ground, but believe also that only optimism gone mad would dare to assert that new methods of getting the oil out of the ground and more economical refining and use of it above ground, will so increase production and reduce consumption that the oil business, like Tennyson's brook, will merrily "go on forever."

What is "oil," or petroleum as it is known in the industry? In the first place, let it be understood that although it is called a mineral, it is actually organic or of animal and vegetable origin. There is today a general consensus of opinion that petroleum is derived directly from the animal and vegetable life of remote geological ages. This theory, which we believe to be the correct one, is based upon the fact that petroleum is found in certain underground layers of sands, sandstones, shales, and limestones. The "sands" as they are called, are believed to have been deposited under water, in remote ages, at the bottom of inland lakes, marshes and the sea.

WHOLESALE WASTE OF GAS

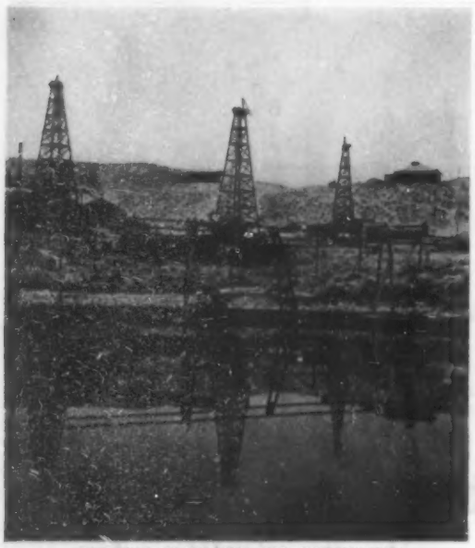
Formerly gas was considered a nuisance and burnt at the well. Today it is conserved and yields ten percent of the total gasoline supply

As the deposits were formed, they included within them the dead bodies of the smaller marine animals such as fish, oysters, mollusks, et cetera, and enormous quantities of the tiny microscopic organisms known as foraminifera. It is also believed that decayed vegetable life was included with the animal remains, for in some of the oils is to be found a certain amount, and in some cases, a large amount of the material of seaweed and land plants. It is believed that heat, pressure, et cetera, acting upon the organic matter of these deposits, formed in the course of ages certain hydrocarbon products which are known to the world as petroleum. These oil sands exist in several separate layers, and they vary in depth below the surface from a few hundred to several thousand feet. Immediately above and below the sands are found impervious layers of shale, sandstone, or limestone, which serve effectually to shut in the gas, oil and water contained in the sands, thereby transforming the latter into vast, more-or-less horizontal, gas-tight reservoirs.

How "Pools" Were Formed

In the course of ages, what was once sea bottom became dry land. As the land was lifted and the enormous pressures due to the slow contraction of the earth's crust under cooling were developed, the oil sands and the adjacent strata lost their horizontal position and were "folded" into what are known as anticlines and sinclines, or gently sloping hills and valleys. It was the folding of the strata and the action of gravity that caused the oil to gather mainly in the upper arches or domes and form the rich "pools" which have proven such prolific reservoirs of oil.

Just here, let it be understood that when we speak of an oil pool, it must not be supposed that the oil is found in great underground lakes. Far from it. As a matter of fact, the hydrocarbons resulting from the decomposition of vegetable and animal matter are found to be rather evenly distributed throughout the enclosing sand or rock. They are locked in the microscopically small voids between the grains of sand, and are invisible to the naked eye. At the office of the Geological Survey, they will show you a core of sandstone which is very rich in



TYPICAL EARTHEN OIL RESERVOIR

When the rush of oil is greater than tanks and pipe lines can carry, it is held temporarily in depressions of the ground. There is loss by seepage and evaporation

oil. To your eye, it is just a piece of buff-colored sandstone, apparently as dry as a bone. Now, the oil sands are under heavy pressure, due mainly to the gas which is condensed within the oil, and also to the heavy hydraulic pressure of water which has entered where the sands outcrop at the surface. The gas, oil and water arrange themselves according to their specific gravities, and in the case of an anticline, such as the famous Teapot Dome, the free gas will be found at the top, followed by the oil and the water.

The pressures in oil-bearing sands are enormous, far exceeding the steam pressure in the average boiler; for in some sands they run up to as high as 1,500 pounds or more to the square inch. When the drill with its enclosing tube or casing drives through into the sands, the age-long conditions of equilibrium are upset. The well forms a vent, and immediately the gas pressure begins to drive the oil out of its myriads of tiny pockets and force it towards the well opening. If there is a pocket of free gas, that is the first material to rush up to the head of the well, and after that comes the mass of oil which, in the case of the great gushers, will go roaring up in a vast column as high as 300 or 400 feet.

As the oil in the mass of sands immediately surrounding the well is driven out, the oil from the more distant sections of the stratum will be forced —squeezed, as it were—out of the sands, and, because of decreasing gas pressure, it will travel more slowly and in less volume. A time will come when gas and hydraulic pressures are insufficient to carry the oil in any volume up to the surface. Recourse must then be had to pumping, which will be continued until the cost of raising the diminished amount of oil is too great to render further operation of the well profitable, when it is abandoned.

In the early days of the oil industry, there was an enormous waste of gas and oil due to their arrival at the surface before adequate provision had been made to receive them. That was the time when, in his eagerness to get at the oil, the miner was wont to look upon gas as something of a nuisance. If there was a town within convenient reach, it would be piped and used for power and illuminating purposes. If not, it was allowed to escape (millions of cubic feet of it) into the air, and frequently, in order to get rid of the odor, it was led away to a pipe or a row of pipes known as "flambeaux," where this valuable product burned away day and night.

Production Losses Diminishing

If indifference, or lack of knowledge and skill, was shown in this deplorable waste of gas, there was also in the early days of oil recovery, and indeed in rather recent times, a great loss of the oil itself, due to the failure to provide for its arrival at the surface. Where a well suddenly began to pour forth oil at the rate of 15,000 to 30,000 barrels per day, the rush would be so terrific as to completely overwhelm the driller and his assistants. In some of the great Mexican gushers, the oil would tear loose the pumping plant and go rushing up through the timber derrick, ripping it to pieces, and flooding the countryside with oil. Sometimes the gusher could be controlled; but in other cases, the oil would continue to escape until the first great rush was over. In hundreds of wells, where no provision had been made for surface storage, the oil would be allowed to flow into some depression, where a dam would hold it temporarily. Here again the waste would be deplorable, for there would be loss by seepage and the richer constituents of the oil would evaporate.

Now, although waste of gas and oil in the early decades of the oil industry was, as we have shown, enormous, and even today is not fully controlled, it must be borne in mind that the experts of the industry are bending every effort toward reducing these production losses. Before the drill enters the oil-bearing sands, in all up-to-date and well regulated oil companies provision is made for turning the gas and oil into tanks and pipe lines, where it can be properly conserved. As a matter of fact, there is comparatively little waste between the well-head and the fuel tank of the steamer, the tender of the locomotive, and the gasoline tank of your own motor car. This loss, including the sojourn of the oil in the storage tanks, its thousand-mile journey in the pipe line, its manipulation in the refinery, and its transportation by tank car and truck to the filling stations, is estimated to be not over 3.5 percent.

THE GREAT LAKEVIEW GUSHER

The oil rushes forth under enormous pressure. The production of this well was 55,000 barrels a day. A few days later the derrick was completely demolished

The largest waste in the oil industry today is underground. For every barrel of oil brought to the surface, three barrels of oil are left in the sands. And that one barrel of oil which we bring to the surface is being most wastefully consumed in the motor car, which, so the experts tell us, burns twice as much gasoline for a given mileage as would be required if carburetors and motors were redesigned with a view to economical operation. Finally, there is the enormous waste of capital involved in the unintelligent drilling every year of hundreds of "wildcat" wells that never bring up a drop of oil.

¶ In our August issue, Chapter III of this series will deal with the present output and consumption of oil and the proposed methods of conservation.

A MAN-MADE FOREST

Wharves and oil wells on the beach in front of Summerland, California

ONE OF THE EARLIEST WELLS

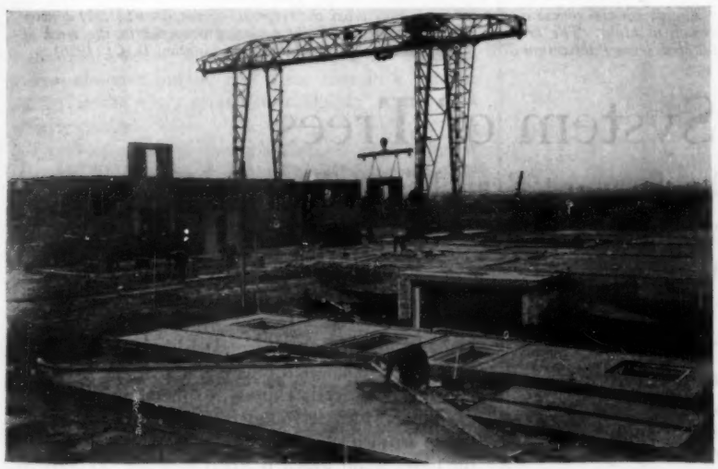
This oil well was drilled as far back as 1864; and it is still producing

HOW THE CONCRETE SLABS ARE MADE

From the mixer the concrete is poured into simple forms which consist of edge-boards, enclosing a space the height of one story, laid on level ground. The rough under side of the slab thus formed is ideal for plastering

Houses Built in Twenty-four Hours!

From prehistoric times, man has aspired to possess his own home. This instinctive desire finds its fulfillment—now that labor and materials have advanced so substantially in cost—for but comparatively few fortunate enough to have a surplus over living expenses. The vast majority must rent. With these rising costs, the rent problem which is presented to the average family narrows down to a question of just the minimum space necessary for existence, in order that the total budget may also include certain items for relaxation or enjoyment which are now considered essential. Much is being advocated by influential individuals; some small amount is being accomplished by organizations with capital. Apparently the solution lies in the fact that only in large undertakings can costs be reduced, so that rentals will be proportionally cheapened, while at the same time more adequate living space is provided. The accompanying illustrations of a project in the suburbs of Berlin show what is being accomplished there in the mechanical construction of community housing. After the concrete slabs are set by the slow but efficient process of drying from one side, the shell of the house can be placed in twenty-four hours. The joiner work, plastering and trim proceed as in other construction. Machinery, cheap labor and cheap, easily obtainable materials are the outstanding features. Further developments along this line are sure to follow the intensive study of the reduction of building costs.



MECHANICAL AIDS ARE USED

This photograph shows a large gantry crane which "straddles" the row of houses, reaching all parts of the buildings and quickly placing material where it is needed

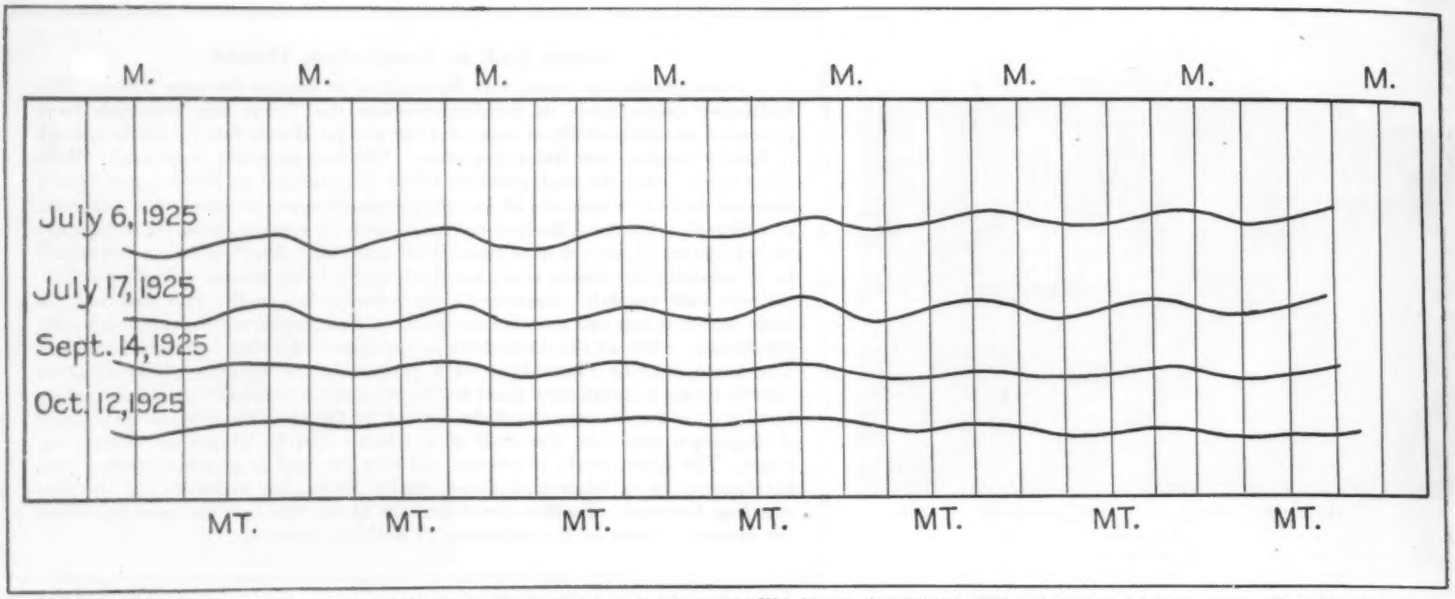
LOWERING THE COMPLETE SECTIONS

The one-story sections are lowered into place and the recessed ends, flushed with cement, are fitted into each other. Three men only are needed for this operation

All photographs from P. and A.

FINISHING IS DONE BY SKILLED LABOR

An auxiliary conveyor supplies the materials for the interior finish of each house in rotation. The main structure is built by cheap labor and handled by machinery, thus minimizing the labor cost. It is so economically produced that the relatively small amount of skilled labor necessary for finishing does not materially increase the total cost



SUCTION FROM THE LEAVES OF A YOUNG WALNUT SHRINKS THE SAP-CARRYING WOOD, REDUCING THE DIAMETER OF THE TREE, ON WARM DAYS

FIGURE 1: *Each wavy line shows the daily variation in diameter for a given week (note dates). The downward course of the curves as they cross the respective noon lines (M,M) denotes shrinkage during most of the day, while the upward course at midnight (MT, MT) denotes expansion at night. The greatest actual growth and daily variation occurred in the week of July 6. No growth and but little variation in October. This and the other diagrams were adapted from Publication 373, of the Carnegie Institution of Washington, D. C. (1926)*

The Hydrostatic System of Trees

The Force that Draws Tons of Sap to the Topmost Branches of Trees Is the Evaporation of Water from the Leaves

By Dr. D. T. MacDougal

Director, Laboratory for Plant Physiology, Carnegie Institution of Washington

TREES maintain sun-driven factories in the leaves for making sugar and other organic substances. Water taken in by the roots is lifted ten, a hundred or two hundred feet to the leaf-mills. Then the liquid products are conveyed downward to all the living cell-masses and out to the extreme tips of the roots, which in tall trees may be three or even four hundred feet from the leaves.

In view of these facts it is not surprising to learn that a distinct hydrostatic system is to be recognized—a hydrostatic system which is not essentially different from that in small plants, except that in trees its working parts are so large that they are readily discernible.

The Leaves Are the Real Pumps

Before proceeding to a discussion of this mechanism we may well rid ourselves of any mistaken idea as to the existence of a "circulation" in a plant, or that the plant has a "heart" or that it shows pulsations. Such imaginative conceptions are wide of the facts and are artistically and sentimentally false and barren.

On a summer day a large tree pulls thousands of liters of water up through the trunk. Of this amount all but a small fraction evaporates and in so doing it furnishes the lifting power which is responsible for the ascent of the sap. The small remainder, perhaps a few liters out of every thousand that reach the leaves, goes into chemical combinations with substances such as the sugars. It makes a solution of these and other organic substances produced in the leaves and then it starts back on the slow downward journey, which has its terminus in the roots.

To illustrate the hydrostatic system of the type prevalent in large, woody plants, a fast-growing pine or walnut may be chosen. These trees form a layer of wood in every favorable year. When the trunk is cut across, this layer appears as an annual ring. The leaves which arise this spring are inserted on or connect with the thin, woody cylinder of the previous year. In the case of evergreen trees, in which the leaves endure a second or third season, leaves connected with two, three or even four layers may be present. This is true, for example, in the case of the pines.

The ascent of the sap always takes place along the conduits of the older wood, with which the leaf-pumps are connected. These water-carrying layers and the living cells external to them, composing the cambium which is found between the bark and the wood, form a complete gas-tight cylinder enclosing the older wood which is filled with air. (Figure 3). The air body in the central wood differs in composition from the atmosphere, and varies with the season. In the autumnal condition the proportion of carbon dioxide in the air of a walnut trunk may be sixty times as great as that of the atmosphere.

The tree-trunk is therefore a hollow cylinder of water extending without break to the surfaces of the water-filled living cells of the leaves above, and down through the roots into the soil, enclosing a central air or gas chamber. The expansion and contraction of this gas body follows changes in temperature and the action of the sap-lifting pumps.

4,400 Pounds Per Square Inch!

The living cells in the leaf, which are the seat of the forces which lift the sap, are distended masses of living matter enclosing vacuoles or cavities containing water in which sugars, acids and salts are dissolved. A cellulose wall surrounds the whole and the water of the protoplasm extends through the ultra-microscopic pores of the wall, ending at the outer surface in minute menisci or curved surfaces such as may be seen when a capillary glass tube is placed upright in a dish of water.

In the latter example the water in the capillary tube will rise to a height determined by the diameter of the tube and surface tension of the water. Similarly the water in the minute tubular pores in the cellulose walls of the leaf cells comes to the surface and spreads into the thinnest of films at the margins. These pores are so numerous and so crowded that a continuous film covers the entire surface of the wall.

Why a Tree Is Not a Standpipe

Have you ever wondered how trees raise their many tons of sap so far aloft? Consider a tree, 100 feet in height, and beside it place a vertical, hollow standpipe of the same dimensions. How could the pipe be filled with water? A suction pump would fill it only to 30 feet. A force pump would fill it to the top, with a resulting pressure of 43 pounds per square inch at the bottom.

But the tree is not like the standpipe, nor has it a mechanical pump. The popular comparison with the standpipe falls down in the case of the tree because the tree draws its sap through thousands of minute pores—tiny tubelets so small that capillary attraction is effective in them. It is the combination of this capillary attraction or surface tension, with the tremendous force exerted in the leaves when the sap that is already in them evaporates, that acts to raise the sap hundreds of feet above the ground.

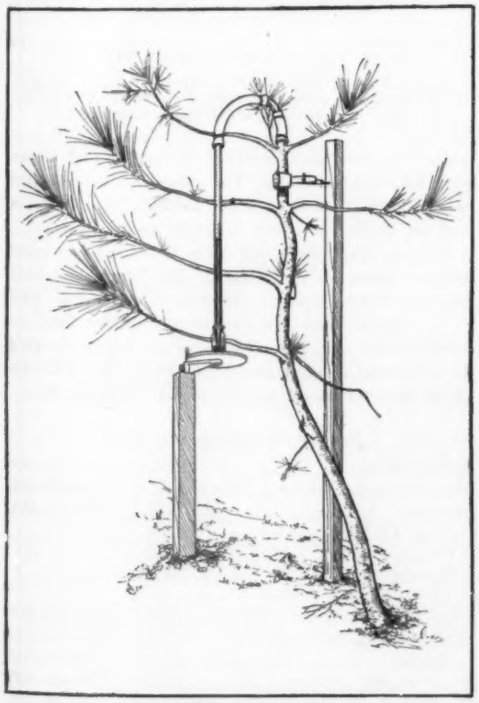
When particles of water are lost from these surfaces by evaporation, water is pulled through the pores in replacement. The water in the pores is continuous with that in the living cells, and this in turn is continuous with the columns in the cavities of the vessels and wood, so that the pull extends to the roots and even to the water in the soil.

The force which may be exerted in this manner may be as great as 200 to 300 atmospheres (2,900 to 4,400 pounds), and thus the sap may be carried upward at a rate of one to three meters per hour. The resistance encountered rises with the speed of the pump. In consequence of the great power exerted by the leaf-pumps, the suction is so great on a warm summer day that the sap-carrying wood is caused to shrink. This is well illustrated by the graphs in Figure 1, which show the varying diameter of a walnut tree at different times. It will be noted that the variation is much less in October when most of the leaves have fallen off.

Immense Force of Surface Tension

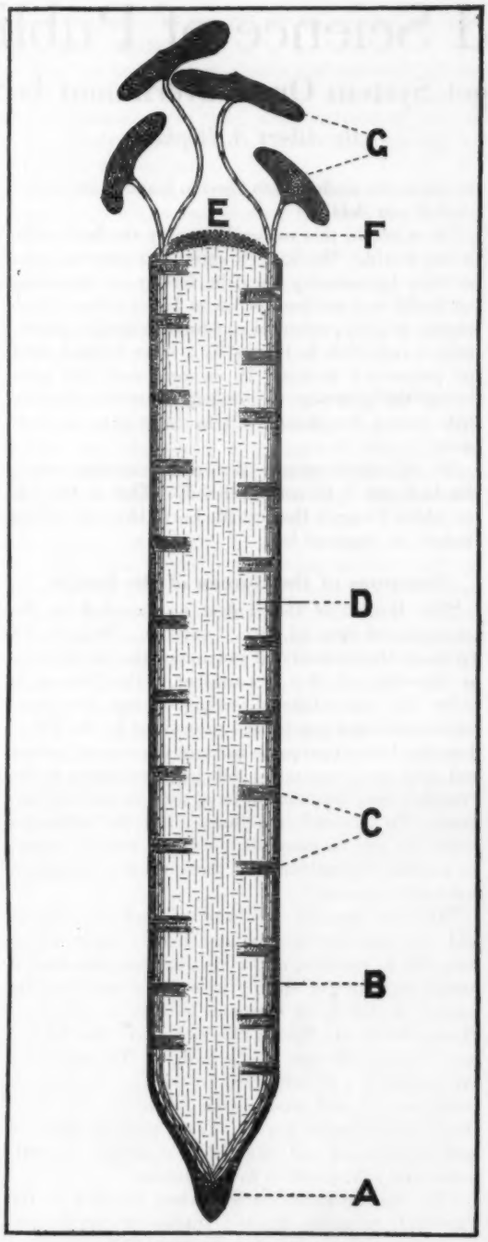
The action described takes place in conduits with bores so minute that the attraction of gravity is far overbalanced by surface tension. If gravity affected the rise of sap, the liquid in a trunk should all run out when it is cut across. Likewise, if gravity dominated the process, the water could not be expected to rise above about 30 feet (like that in a suction pump), or to the equivalent in weight of the barometric column.

The conception of the cohesiveness of a column of water, which is so great that it will hang together like a rope, is not one which can be illustrated by obvious facts in common experience, yet it may be readily demonstrated in the laboratory. In this test a clean glass tube of small bore is fitted tightly with a clay cylinder such as those used in water filters or with an evaporimeter of similar material. The tube and the clay cylinder having been filled with water, the open end of the tube is stepped in a dish of mercury. Water evaporates from the menisci of the clay surfaces, to be replaced by water from within. Thus mercury is pulled up from below. This action may continue until a column of mercury much higher than the barometer is drawn up into the tube, even though the latter has a bore thousands of times as great as the cavities of the conduits of trees. If it were possible to make and manipulate glass tubes in this apparatus as small as the wood conduits, a mercury column could doubtless be lifted many meters high.



DEMONSTRATING TREE-TOP SUCTION

FIGURE 2: *A glass tube immersed in mercury is connected to the upper end of a pine tree by rubber tubing. Here, suction has pulled up the mercury seven inches*



THE SAP SYSTEM OF A TREE

FIGURE 3: *The heavy, outside shading denotes the layer of living cells on the outside of the wood. This layer terminates in the roots, A, the buds, E, and the leaves, G. Layer B is recently formed wood. The leaves are shown inserted on the second and third layers, as in a pine tree. D is old wood, containing gases. C, C, are rays including living cells*

It is not to be supposed, however, that the plant physiologist has cleared up all of the features of the movement of sap in plants. He is not so sure, for example, as to what takes place at the foot of the water column in the roots as he is as to the action in the leaves. The pull from the leaf-pumps may extend not only to the extreme surfaces of the roots but out into the soil, and doubtless does so in some plants. In many plants, however, an osmotic action takes place in the roots. This pulls water in from the soil, and forces it upward in the wood so that if the stem be cut off it will exude from the stump. This action is notable in grape vines, palm stems, birch trees and in many other common species. This "root-pressure," as it is called, is invariably complicated; the "bleeding" of a pruned vine or shrub is partly due to other agencies.

The suction and sap pressures in plants have engaged the attention of experimentalists since the time of Nehemiah Grew (1682).

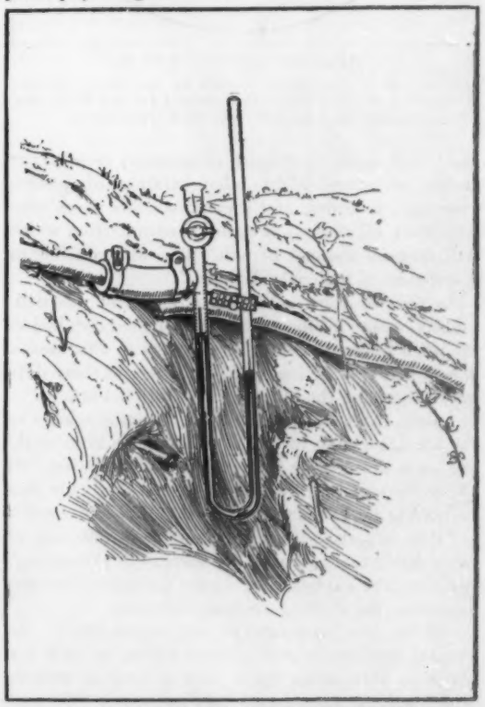
Gages attached to the bases and stumps of trees have shown apparently discordant results, in the hands of scores of workers. The identification of the hydrostatic system as described above has made possible the interpretation of pressures in various parts of the root, trunk or branches.

Thus, if a manometer is attached to a bore in the outer wood of a walnut tree a suction will be shown in the midday period when the leaf-pumps are in action pulling upon the water column. Simultaneously, another gage driven in to connect with the gas-filled wood of the center of the trunk may show a positive pressure. This is due to the temperature expansion of the gases.

How Roots Suck Water

Again it is notable that a gage attached to the cut stem of a pine tree (Figure 2) shows nothing but suction, anything like "root-pressure" being lacking, and the expansion of the gas in the central core acts to diminish suction but never to give positive pressure. Similarly a gage attached to the terminus of a cut root of pine (Figure 4) will always show suction, although positive pressure is sometimes measured by a gage attached to the root of a walnut tree. The hydrostatic system of the conifers differs in many important features from those of the dicotyledones.

The features of the hydrostatic system as delineated above furnish an adequate mechanism for carrying water or sap upward in trees. The path by which the indispensable products of leaf-activity are carried downward to all the living cells lies in the external part of this system but it has not been definitely localized. This and the nature of the forces involved remain as unsolved problems to the plant physiologist.



LEAF SUCTION FELT AT THE ROOTS

FIGURE 4: *A U-tube filled with mercury is connected with the cut end of a pine root. Suction originating in the leaves has pulled the mercury up to a height of three inches*

The Applied Science of Public Spending

Through an Effective Budget System Our Government Is Saving Millions This Year

By Albert A. Hopkins

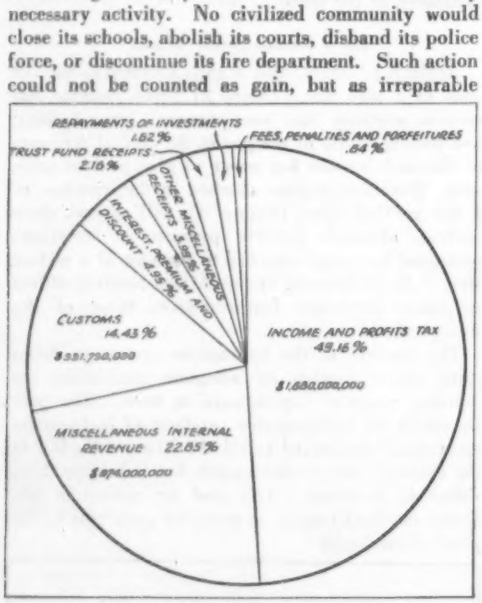
YOU cannot eat your cake and have it, too, is an old saying which embodies more truth than poetry. Yet that is the very thing the Government of the United States is now trying to do—cutting its income, cutting its expenses and still having more to show for its money.

And how is it accomplishing this anomaly?

By a scientific budget system.

President Coolidge explained the principle of it on January 30, last, over the radio.

"Merely to reduce the expenses of the Government might not in itself be beneficial," he said. "Such action might be only the discontinuance of a wholly necessary activity. No civilized community would close its schools, abolish its courts, disband its police force, or discontinue its fire department. Such action could not be counted as gain, but as irreparable loss. The underlying spirit of economy is to secure better education, wider administration of justice, more public order, and greater security from conflagration, all through a superior organization which will decrease the unit of cost. It is all reducible to a question of national efficiency."



ESTIMATED RECEIPTS FOR 1927

The estimated government receipts by sources of revenue (excluding the Post Office Department) for the fiscal year ending June 30, 1927, may be $3,824,530,203

In the good old days when government was deliciously simple all the sultan or the maharajah had to do when he wanted more money was to raise taxes. It was the more or less loyal taxpayers in those days who originated the slogan, "Give till it hurts."

Lately, the men who have been applying science to the administration of public affairs have been working on a different theory. Instead of adopting "all the traffic will bear" as their motto, they figure that increasing the traffic will produce still better results.

"Past experience has shown that a reduction of taxes has been followed by increased prosperity," Mr. Coolidge explained. "As the volume of business increases, the Federal revenue increases.

"If we are moderate in our expenditures, the natural increase in profits ought within the next few years to furnish us again with a surplus revenue which will permit a further tax reduction. We were the first nation in recent years to adopt a plan to reduce our debt and put the plan into operation. We are maintaining our sinking fund and applying the payments made on our foreign loans to the retirement of our debt.

"As a result, this nation has today the best credit in the world. We have lowered our interest costs not only by reducing our debt, but by so improving our credit that we can borrow at lower rates. Since interest is 22½ percent of our total Federal expenditures, a reduction in interest is a more fruitful field for permanent saving. If we continued this plan during the post-war depression, there is certainly little reason for changing it in these days of prosperity."

All of which sounds like good common sense. But how can it be accomplished? That is the job for which General Herbert M. Lord, Director of the Budget, is responsible.

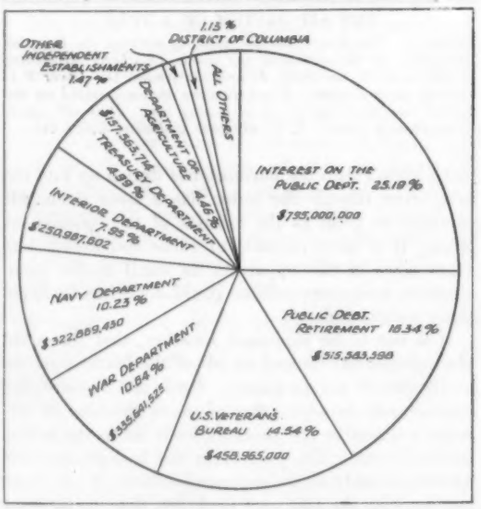
Functions of the Bureau of the Budget

"The Bureau of the Budget was created by the act approved June 10, 1921," says he. "It is in the Treasury Department but not under the jurisdiction or direction of that department. The Bureau is under the immediate direction of the President. Under rules and regulations prescribed by the President, the Bureau prepares for him the annual budget and such supplemental or deficiency estimates as the President may recommend from time to time to Congress. To this end, the Bureau has the authority, under the act, 'to assemble, correlate, revise, reduce, or increase the estimates of the several departments and establishments.'

"The act requires the head of each department and establishment to appoint a budget officer whose duty it is to prepare, under his direction, the departmental estimates of appropriations and such supplemental or deficiency estimates as may be required. These officials are liaison officers between the department and the Bureau of the Budget. The estimates are prepared and submitted to the Bureau in such form, manner and detail as the President prescribes. On or before September 15 of each year, the head of each department and establishment revises his estimates and submits them to the Bureau.

"The Bureau is authorized, when directed by the President, to make detailed studies of the departments and establishments for the purpose of enabling the President to determine what changes should be made, in the interest of economy and efficiency, in (1) the existing organization of activities, and methods of business of such departments or establishments, (2) the appropriations therefor, (3) the assignment of particular activities to particular services, or (4) the regrouping of services.

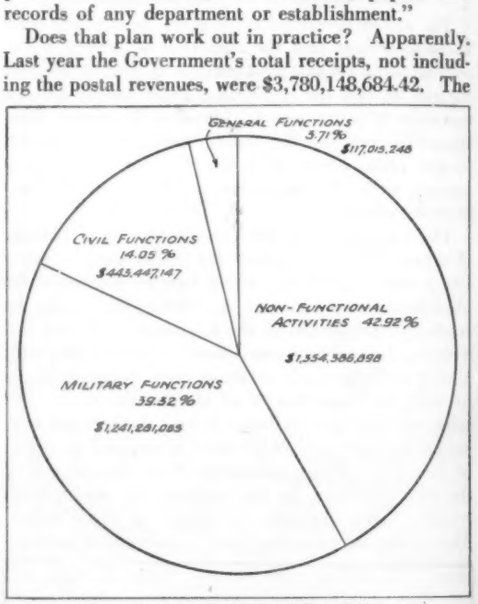
"Each department and establishment is required, under regulations by the President, to furnish to the Bureau such information as the Bureau may from time to time require. Officials of the Bureau are given the authority to have access, for the purposes of examination, to the books, papers and records of any department or establishment."



ALLOCATION OF THE AVERAGE DOLLAR

The United States Government will appropriate for the fiscal year ending June 30, 1927, $3,156,130,358. There is a difference between "Estimated Appropriations" and "Estimated Expenses." The latter figure is $3,494,222,308

Does that plan work out in practice? Apparently. Last year the Government's total receipts, not including the postal revenues, were $3,780,148,684.42. The total expenses, also leaving out the postal items, were $3,509,643,446.09. The excess of receipts over expenditures, therefore, was $250,505,238.33—not a bad net profit for a big business establishment.



WHERE THE APPROPRIATION WILL GO

The Post Office Department is not included. The amounts for the fiscal year ending June 30, 1927, will be $3,156,130,358. Note the size of "Military Functions"

What is happening this year is, of course, more or less a matter of conjecture. The figures that have been set down, however, have been verified so well by past experience that we may consider them as substantially accurate. The annexed tables showing the estimated receipts and expenditures for 1926 indicate that our excess will be about $262,041,756.

ESTIMATED RECEIPTS FOR 1926

Income Tax		$1,880,000,000
Miscellaneous (Internal Revenue)		854,000,000
Customs		556,750,000
Foreign Obligations:		
Principal	$ 31,257,243	
Interest	163,377,046	
	$194,634,289	$194,634,289
Miscellaneous Sources		139,701,343
Securities		123,869,853
Trust Funds		75,961,827
Proceeds from Surplus Property		24,799,630
Panama Canal Tolls, etc.		21,000,000
		$3,880,716,942

ESTIMATED EXPENDITURES FOR 1926

Interest on the Public Debt.	$820,000,000
Public Debt. Retirements Chargeable against ordinary receipts	500,428,595
U. S. Veterans' Bureau	388,515,000
War Department	347,289,031
Navy Department	342,305,000
Interior Department	293,867,508
Refunds of Receipts	186,247,500
Operations in Special Accounts, Shipping Board, War Finance Corporation, Alien Property Funds, etc.	183,899,047
Department of Agriculture	162,901,222
Treasury Department	132,237,928
Investment of Trust Funds	49,542,050
Postal Deficiency	37,067,449
District of Columbia	36,516,448
Other independent Offices and Commissions	32,179,331
Department of Commerce	29,427,640
Department of Justice	25,053,160
State Department	16,135,032
Legislative Establishment	16,011,245
Panama Canal	10,213,394
Department of Labor	8,355,599
Executive Proper	483,007
	$3,618,675,186

The figures above are for the calendar year. The estimates for the fiscal year ending June 30, 1927, were submitted to Congress last December. The receipts are estimated at $3,824,530,203 and the expenditures at $3,494,222,308.44, making the surplus $330,307,894.56.

The best laid schemes o' mice and men and budgets gang aft agley, however, and no matter how carefully estimates are made, some unforeseen leak is more likely than not to drain off the savings of efficiency and economy.

Notwithstanding all the bad luck which tends to wipe out a hoped for surplus, however, the Bureau of the Budget succeeded last year in really reducing expenses $60,000,000 or $166,666.67 for every day; $6,944.44 every hour. One of the plans used to bring this about was a "Two Percent Club," the various bureaus engaging to reduce their programmes two percent.

Government Sets Example of Thrift

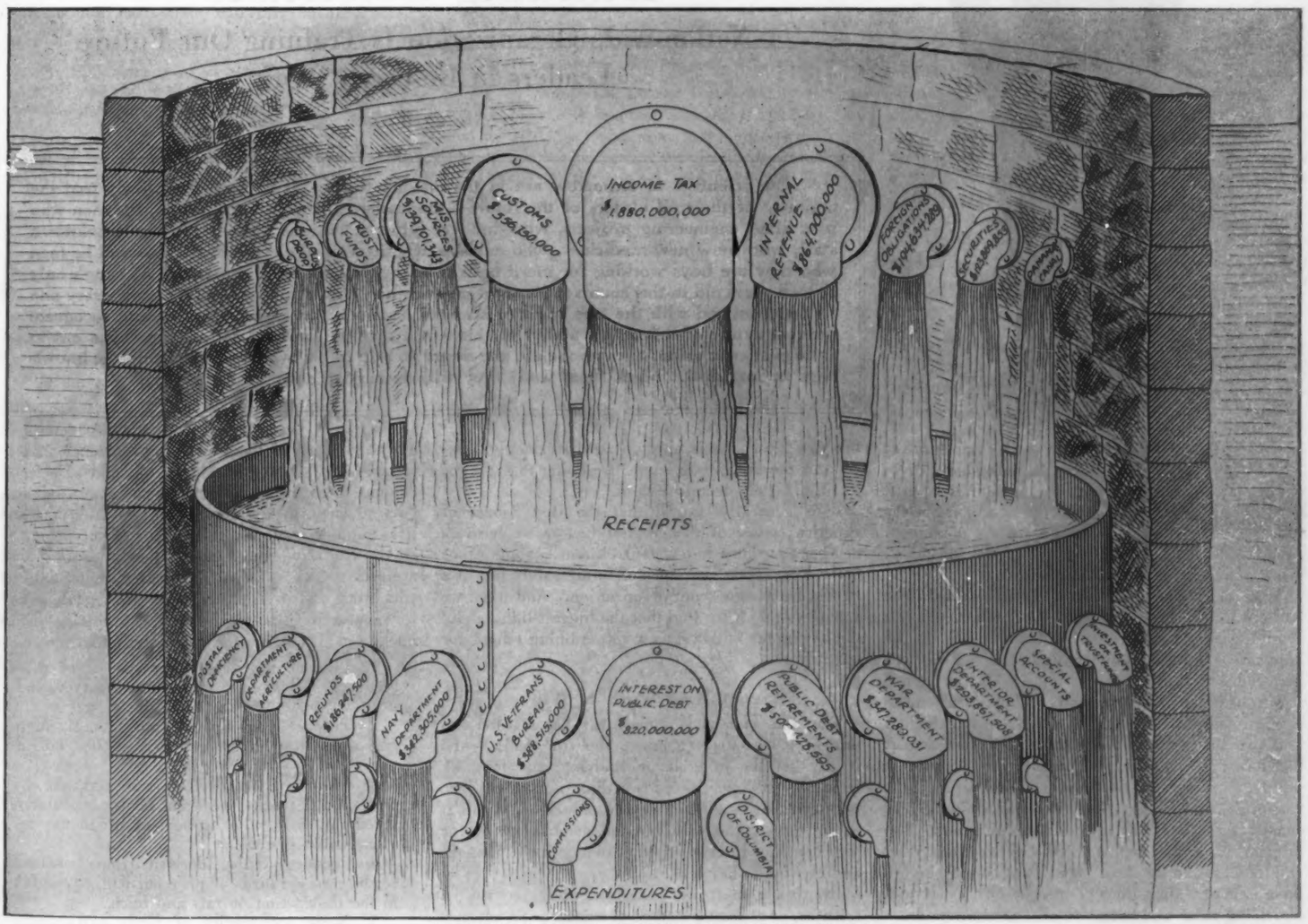
"I was notified by telegraph that the Navy had joined the club with a guaranteed reduction of $6,600,000 in its estimated expenditures with hope of a further reduction of $2,000,000," says General Lord. "It was an inspiring beginning. Throughout the length and breadth of this country was broadcast the Navy's gallant response to this call to arms in the interest of reduced spending and lower taxes. But, when the smoke of the battle cleared away, the Navy was found in the list of casualties, with an expenditure of $14,000,000 in excess of its original estimate, rather than $6,600,000 less—a change amounting to $20,600,000.

"The Army promised nothing, and kept its promise by spending $17,000,000 more than it estimated. But the Army got no advertising out of it except what it is getting now." The Director then goes on and gives the names of the departments and bureaus that made the grade and proposed a 'One Percent Club' to lop off at least one percent of the estimated expenditures.

"The Federal Government in reducing its expenditure, cutting its taxes, and lowering its debt," he continues, "is setting an example of thrift to other taxing agencies in this country which should help materially to reduce the cost of living so that the child's faith in and respect for the penny may be renewed, the quarter may again become a respectable member of financial society, and the dollar again lift its head in the marts of trade."

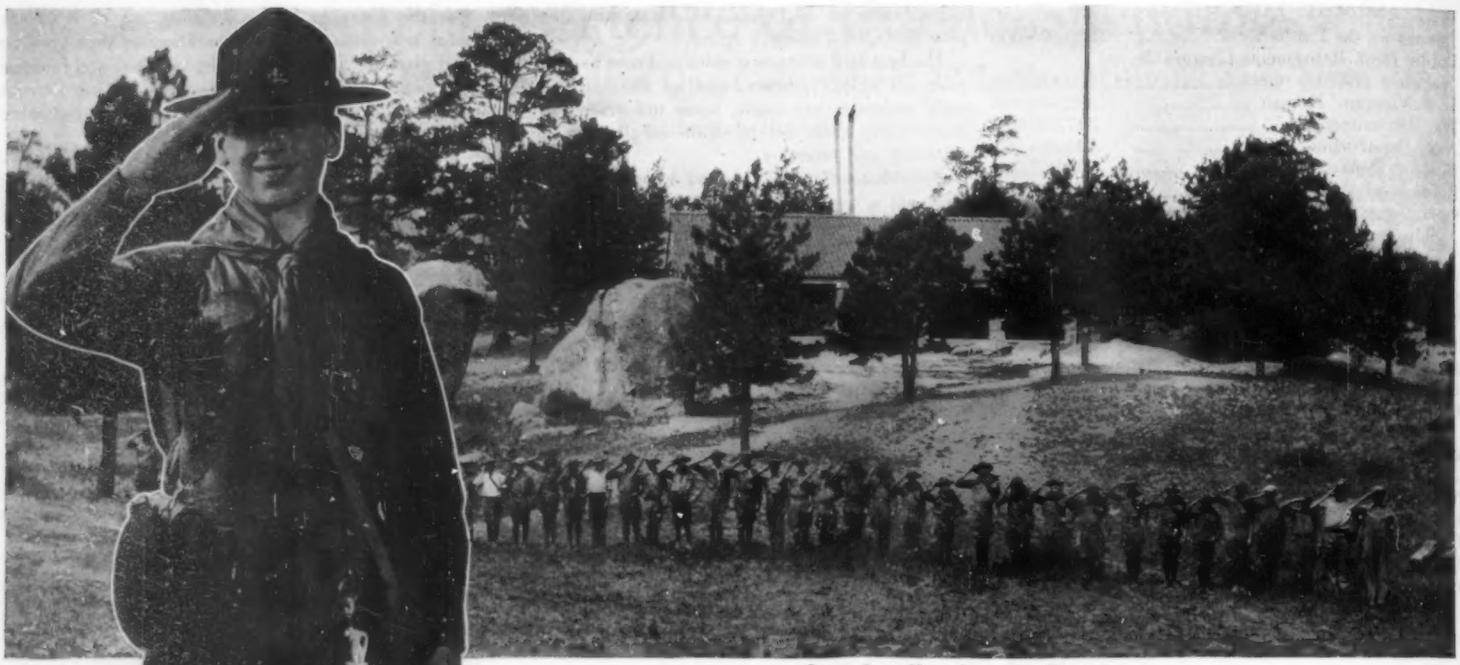
The Government payroll on December 31, 1925, carried 114,696 fewer employees than it carried on December 31, 1920, making a yearly saving of $138,000,000. The reduction excludes the postal service, which is a constantly growing activity requiring more and more workers every year. Of the officials who have cooperated with the Bureau of the Budget to bring this to pass, General Lord says:

"We wonder how we managed so many years without them. They have been helpful in so many ways, have straightened out so many tangles, have contributed so materially to good fellowship in the service, have so worn down the old barriers that separated departments from departments and bureaus from bureaus, that they stand today the acknowledged apostles of teamwork and efficiency, which march hand in hand."



HOW UNCLE SAM IS MANAGING HIS AFFAIRS IN 1926

Estimated receipts, $3,880,716,942 for 1926; estimated expenses, $3,618,675,186 for 1926. Our comparative illustration shows the estimated receipts and estimated expenditures for the year 1926 based on Treasury estimates. It should be remembered that the Postal Establishment is not considered except when there is a postal deficiency



SCOUT CAMP NEAR CHEYENNE, WYOMING

Budding Scientists

A Nation-wide Organization Is Training Our Future Leaders in Research Work

By Milton Wright

Our scientists of tomorrow are in the making today. It is more than likely that the majority of the trail blazers of the future—the leaders of thought and action, the men who plan giant engineering projects, who discover hitherto unfound germs, who locate unknown stars, who brew new medicines, who achieve new marvels of electrical energy—will be men who now are boys working for merit badges in the Boy Scouts of America. Although only sixteen years old in this country, the scout organization now numbers 613,087 boys, every one of them imbued with the true spirit of scientific research, the capacity to see and recognize the real nature of things, the ability to think in a straight line and follow a premise out to its logical conclusion, and, above all, the desire to add to his own knowledge and the knowledge of mankind. Mark them well; they will do a good turn for humanity.

SURROUNDING the little cemetery at Oyster Bay, Long Island, where Theodore Roosevelt lies buried, is a bird sanctuary given to the Audubon Society by the sons of the former President. In this sanctuary, near Roosevelt's grave, stands a grove of beautiful black walnut trees.

America has never known a better tree than the black walnut. From no tree in all the world has ever dropped a sweeter nut. And yet, this is the very tree that has suffered most in the ruthless cutting down of our forests.

Through that grove every year boy scouts make a pilgrimage to do homage to their former leader. Last year they stopped and gathered up every walnut that had fallen. They sent them to scout troops in other places. The other scouts planted them as memorial trees. From all parts of the United States came requests for nuts for planting purposes. The pilgrim scouts will repeat the distribution this year, and the next and the next. It will not be long before thousands of walnut trees planted by boy scouts will be adding value and beauty to all our countryside.

Such an enterprise is practical conservation. Many a scientist toiling for a lifetime will accomplish less for his fellows. It is only one small example, however, of the things boy scouts are doing to make the world a better place to live in.

It is generally agreed that the Boy Scouts of America is one of the greatest factors we have in making raw boys into useful citizens. Some of us believe the surest guarantee of future safety lies in a strong, broad boy scout organization. And when we come to study it we find that the biggest thing about the boy scouts is that it is a vast training school for scientists.

Scout Must Work to Win

The true scientist is a man who has learned two things: to see and recognize the true nature—the reality—of the thing he is studying, and to think in a straight line. These two things, above all, the boy scout learns. Stain a piece of wood and call it mahogany, if you will, but the scout knows it for pine; put two and two together in any line of thought and he knows they make four.

Even in a narrower sense the boy scout is a scientist, or at least a student of science. To advance in scoutdom a boy works to win the much coveted merit badges. There are seventy-one of these badges and thirty-four of them are for proficiency in subjects which fall well within the domain of science. Among these are agriculture, astronomy, aviation, botany, chemistry, conservation, electricity, insect life, mining, photography, radio and surveying.

All over the United States thousands of scouts are taking tests in these and kindred subjects. Lest you think such tests are merely superficial, glance for a moment at some of them. To obtain a merit badge for bird study, for example, a scout must:

1. Produce a list of forty species of wild birds which have been personally observed, and positively identified in the field.
2. Produce a list showing the greatest number of species that he has seen in the field in one week.
3. Produce a list, derived from personal observation, of twenty species of birds particularly noted for their value to agriculture in the destruction of insects.
4. Produce a list, derived from personal reading, of ten birds of prey particularly useful in the destruction of rats and mice.
5. Name ten species of birds particularly useful in protecting the trunks of trees from borers, bark-lice and scale insects.

6. Describe at least two bird boxes and two food tables that have been erected by him, the species of birds that have been attracted by them, and how many of the birds have nested in these boxes.

7. State what he has done to protect birds from wicked and unjust slaughter; to promote long, closed seasons for vanishing species; and to promote the creation of bird preserves and sanctuaries.

Or take botany. Could you meet this simple test that a boy scout must pass in order to obtain a merit badge:

1. Produce specimens of 50 species of 5 flowering plants without the roots (and in addition, where possible, 5 ferns) collected and named by himself.

2. Be able to identify 10 plants by their seeds. Produce specimens of the seeds.

3. Give a list of at least 5 plants that are usually found growing together in woodlands, or 5 near water; and 5 found in open fields, or 5 along roadsides. Produce specimens.

4. Tell the parts of a complete flower. Submit drawings.

5. Tell in a general way how plants manufacture their food.

6. Explain how ferns differ from flowering plants; and tell how they are reproduced.

7. Submit specimens collected by himself (with names if known) of 5 Fungi, 5 Algae or 5 Lichens; 5 Mosses or 5 Liverworts; or if specializing in any one of the above classes, submit 10 different species of that class.

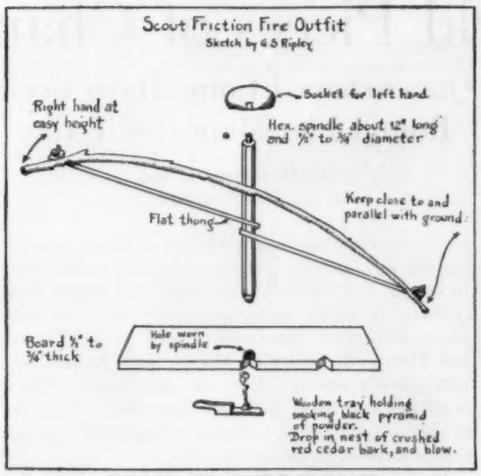
8. Name 5 kinds of edible wild fruits; 5 plants used medicinally and tell what used for; 3 wild plants that can be cooked as "greens," and 2 edible "roots."

9. Submit an essay of at least 200 words on the "Conservation of Wild Flowers," naming at least 4 in danger of extinction.

Eliminating Square Pegs in Round Holes

All too often men's lives are wasted because they never found themselves. There are potential metallurgists of distinction who are teaching country schools, men who might have become great geologists instead of mediocre bookkeepers. They never got started on the right track. Thanks to the boy scouts, however, there are fewer such misfits than there used to be, for, as almost nothing else we have, scouting tends to bring a boy face to face with the career for which he is best fitted. Thousands of youths today are on the way to make distinct successes of their lives because of the inspiration and early training they received in the local scout troop.

Last year surveys were made at nine institutions of higher education to determine what percentage of



THIS IS ALL THERE IS TO IT

A few pieces of wood, a flat thong, a pinch of powder and you have a fire-making kit. The only thing that remains is the knack of working it

the students had been scouts. Here is the way they showed up:

	Percent
Washington and Jefferson College, all classes	64
University of Oregon, freshmen	52
United States Naval Academy, all classes	50
Harvard University, all classes	49
Rhodes Scholars for 1925	48
United States Military Academy, all classes	48
University of Michigan, freshmen	44
Yale University, all classes	38
Lafayette College, all classes	33

The percentage of former scouts among college men is especially impressive when it is considered that the 613,087 scouts constitute only a small percentage of the boys of scout age in the country.

Not only do the scout-trained boys bulk large in numbers among college men but they stand out by reason of the quality of their scholarship. Thirty-two college men won Rhodes Scholarships in 1925. Fourteen of them were scouts, and of the remainder, four expressed regret that they had never been scouts, a fifth praises scouting highly and a sixth is acting as an assistant scoutmaster.

A typical scout in college is Dudley Smith, of Independence, Missouri. Dudley joined the scouts at the age of 13 and devoted his spare time signaling, camp cooking, swimming, firemaking, first aid and other scout work. Passing the tenderfoot, second and first-class tests, he began to earn merit badges for the life, star and eagle scout standing. One of the subjects he took up was bee keeping. His interest brought him a hive as a birthday present; under his care it grew to eight hives. The honey he sold brought money for camping trips and for many other pleasures.

To earn a merit badge in dairying he took charge of the family cow, marketing the milk. Winning badges, in short, led him to good scholarship, health habits, scientific study, research and experimentation.

Making fire by friction especially interested Dudley. Trying it first with a home-made set made from a sketch took him more than five minutes. Then he began experimenting. His research in spare time, trying various bows, hearths, spindles, tops, tinder and thongs, extended over three years. Every month or so he lowered his record a bit. Soon he began to break records and one day made a new speed record for scoutdom in making fire by friction.

Other scouts began urging him to make fire-making sets for them. Scoutmasters began ordering sets by the dozen, then by the hundred. Eventually he had a fire-set business that has earned him enough money to start him in college. He is now finishing his second year and sees the rest of his college course coming to him through scouting.

Their Knowledge Put to Use

More and more the scouts are concentrating on science. Here and there troops are establishing museums for specimens they have collected. At Bear Mountain last year 12,000 scouts were encamped; smaller camps dotted the country. And every one of the campers was a science student. It is in the minds of the directors to have scientists going from camp to camp instructing the boys, but the scouts will continue to do their own research, going direct to the heart of things and finding out for themselves, as all scientists should.

What the boys learn is of direct and practical value. How often do we pick up a newspaper and read some such headline as: "Scout's First Aid Saves Chum's Life," "Scouts Fight Gipsy Moth Plague," "Scouts Building Trails Through National Forests"? Good, scientific jobs, all of them.

Men study sciences in colleges and universities, and after four years receive the degree of B.S.—bachelor of science. But there is another B.S. degree—boy scout. It too, means science, and who shall say that any other degree augurs better for the future of our country.

NOT A NAIL IN IT

This miniature bridge made by a scout of Santa Clara County, California, staunch enough to support an automobile, suggests the strong foundations the scouts are building on

DANIEL CARTER BEARD

The National Scout Commissioner, friend of boys for half a century, and loved throughout the nation, is the "grand old man" of scoutdom. He founded the organization in 1910

MATCHLESS SKILL

Scout Dudley Smith demonstrates how to have fire going in seven seconds. Starting a blaze by friction is an accomplishment everybody in the organization strives to learn

Odd Pieces of Change

A Weird Miscellany of Queer-shaped Coins Have Been the Forerunners of the Round Flat Money of Today

By Howland Wood
Curator, American Numismatic Society

THE general conception of a coin or piece of money is that it is round and flat. This form has stood the test of centuries and, in fact, is a refinement and gradual improvement of the earliest coins. It is the common-sense form, because it is the most adaptable for carrying, storing, handling and counting. There have been, however, so many exceptions and there are so many odd shapes in coins, that a casual survey of the field is of interest.

The first coins were simply crude lumps of metal bearing a simple stamp. For the most part they were globular in general form; but, as time went on, they became flatter and more circular. The absolute flatness of the two sides, so that all raised parts should sustain an equal wear, apparently was not a major consideration until fairly modern times. Although the general circular shape was adopted early, exact roundness was not universally attempted until modern coinage methods came into vogue a few centuries ago. For the most part, we must look to the Orient for odd-shaped coins, although Europe and America provide examples of every period.

In parts of the world where there is a lack of minting facilities, we find coins, now and then, in the shape of bars, or that were obviously made from bars. One of the commonest examples is the bar money of Java and Ceylon. These coins were made from long, cast-copper bars, cut into different lengths according to the denominations of the coin to be made. In Siam, silver ingots were beaten into bars which were then pounded into peculiar shapes. The older shapes show a deep cut in the middle and two peculiar bendings. Later shapes were made into a more compact form known as "bullet money."

"Coins" Weighing 48 Pounds

Closely related to this form are pieces of money made from wire. The commonest examples are known as larins or "fish-hook-money," probably first made in Laristan, in Persia. These are pieces of silver wire about three inches long, doubled over, with one end curved. Similar pieces were made in Ceylon; and other straight pieces of wire were used in parts of India. Similar shorter pieces in copper, though still bent double, were used at Nejd, in Arabia, and in Georgia, in the Caucasus.

For over a hundred years, in the Seventeenth and Eighteenth Centuries, large flat copper plates bearing several small stamps on them came into use in Sweden. These cumbersome pieces ranged in denomination and size from ten dalers—weighing about 48 pounds and measuring nearly two-and-a-half feet long by about a foot wide—to small square pieces of less than an inch in diameter.

During sieges of cities and in periods of necessity when temporary and emergency mints were established, many silver coins were cut from sheets of silver into square, octagon or irregular shapes, and stamped with small punches. An interesting example of a piece of money cut from a silver bowl and still showing the rounded rim is afforded by a piece struck at Landau in 1702. During the Sixteenth and Seventeenth Centuries, many coins normally made round were often, for special reasons, such as commemoration, made square, hexagonal or octagonal.

India has always been partial to square coins. The earliest pieces, known as "puranas," were square pieces of silver bearing a number of small stamps. During the Bactrian period, and later, many coins in copper and silver were struck from square dies.

Many medieval coins, especially the very thin pieces known as "bractiates" issued in the Twelfth and Thirteenth Centuries, chiefly from Switzerland, were simply square pieces of sheet silver. These bractiates are interesting in themselves. They are as thin as paper, with a design in high relief on one side and countersunk on the other.

In the gold-mining days in California, fifty-dollar gold pieces, known as "slugs," were struck in an octagonal form. In recent years, the more easily to distinguish them from silver coins, nickel money was introduced in odd shapes. The recent British Indian coins are illustrations of this practise. The

A PRODIGIOUS COPPER COIN

In Sweden, during the Seventeenth and Eighteenth Centuries, copper plate money was stamped with dies. Some of these were nearly two and one-half feet long

one-anna piece is scalloped; the two-anna piece is square, with rounded corners; and the four-anna piece is a scalloped octagon. Several of the nations have made their nickel coins round, but with a central hole to make them easily distinguishable.

The Mogul Emperor Akbar, in 1574, struck a gold coin of a peculiar pattern in Agra, India, which is known as a "mihrabi mohur," because its shape resembles a "mihrab" or prayer niche in a mosque. Some of the most peculiar conceptions of coinage emanate from Burmah and the Malay Peninsula. The Siamese coins have already been mentioned; but to the north and to the west, on the Burmese border, are found long, rough, cast-copper bars, and some smaller pieces cast in the shape of canoes. At Pahang, in the Malay Peninsula, tin coins somewhat resembling square hats with a wide brim were in general use at one time. At Kedah, small oval tin coins and pieces in the shape of a rooster on a series of rings, were used as currency.

The ancients seldom deliberately made coins departing very much from the round or globular shape. There are, however, a few noted examples. At Olbia, on the Black Sea, there was coined a bronze piece in the shape of a dolphin; and in Italy, at Iguvium, certain almond or oval-shaped copper coins were made. There is also a class of coins of irregular shape which were largely the result of indifference or carelessness. Some of the ancient Greek and Roman coins are most irregular, due to the hastily or poorly fashioned planchets on which the pieces were struck. Many of the copper coins of Georgia, made in the Middle Ages, show that often they were struck on pieces of metal which had been simply poured out onto a flat surface, as were, in a similar way, many of the silver pieces from the various mints in Spanish America.

Coins originally round have often been made fantastic in shape by cutting. This was practiced to some extent in ancient times and during the Middle Ages. But the most curious, and possibly the most common, practice was that employed in the West Indies from 200 to 100 years ago. On these islands, large quantities of Spanish dollars or pesos were cut to make small change or to make the pieces conform to new monetary standards. The commonest practice was to cut a dollar into segments, quarters, sixths, twelfths, et cetera. Sometimes the piece was simply cut in half. On some of the islands, they were cut into three horizontal pieces. Often holes of various sizes and shapes were made in the coins, when both the plug and the ring were used.

Bizarre Shapes Prevailed in the Orient

So far, no mention has been made of the coins showing Chinese influence. In this series alone are found many bizarre shapes. To understand the reason for some of these shapes, it is sufficient to say that the first Chinese coins were a transition from the barter stage, and the forms employed were similar to the units of value from which the coins were derived. The most common of the ancient forms were what are known as "knife coins." These were in common use for several centuries before the Christian Era. Another common type is known as "Pu," or weight, fork or spade coins, derived probably from some agricultural implement. Both of the above forms were revived a few centuries later by the usurper Wang Mang, about the beginning of the Christian Era. For silver, the Chinese have used for centuries, cast ingots of special forms. The most common shape is known as "shoes" which weigh from a fraction of a tael to fifty taels. In Annam, one of the most common forms of silver or gold money is the rectangular bar of varying sizes. In Japan, about 1860, gold and silver money appeared in thin oval sheets, or smaller and thicker rectangular pieces.

A survey of the numismatic field shows that except in the Orient, coinage as a whole has been flat and round, and that when deviation from this practise has occurred, it has been largely a matter of temporary expediency, experimentation, or effort to distinguish a particular coin from those coins in current use. For easy identification, the odd-shaped pieces of recent years have usually been of nickel.

These Were Once Used As Coins

1. Early Greek coin showing globular shape. 2. Coin cut from piece of copper bar made by the Dutch in Java about 1800. 3. Early Siamese coin cut from silver bar and then bent. 4. Silver wire money from India. 5. Georgian coin made from copper wire. 6. Coin struck at Haarlem when besieged by the Spaniards in 1572. 7. Coin issued during the siege of Landau in 1702, showing the rounded edge of the silver dish from which the blanks for the coins were cut. 8. A Bactrian coin of India. 9. A square rupee of Akbar the Great of Hindustan. 10. An early small silver coin of Switzerland known as a "bracteate." 11. The octagon slug of California struck in the early gold-mining days. 12, 13, 14. Types of recent British Indian nickel coins. 15. Canoe-shaped coin from the Lao States, north of Siam. 16. The "Mihrabi Mohur," of Akbar. 17. The "tin hat" money of Pahang. 18. An oval coin from Kedah. 19. A most bizarre coin from Kedah. 20. An oval copper coin made at Iguvium, in Italy. 21. A Greek coin of the Island of Aegina, struck accidentally on an ill-formed planchet. 22. Many of the copper coins of Georgia in the Middle Ages were struck on odd-shaped plans. 23, 24. Seventeenth Century Mexican coins struck on irregular pieces of metal. 25. A Spanish dollar, cut in quarters, used for money in the West Indies. 26. Small change of the Island of St. Lucia. 27, 28. Chinese coins made about the beginning of the Christian Era. 29. A silver tael known as a "shoe." 30. Form of Chinese Sycee silver. 31. An Annam silver coin. 32. A Japanese silver coin at the time when Commodore Perry landed. 33. Holed Spanish dollar used for 16 Bits at Dominica, and the piece extracted used for two bits. 34. An early form of a knife-shaped coin of ancient China. 35. This is a coin of ancient Cathay and is known as Pus.

X Rays and Atoms

By Means of Crystals or Powders the X Rays Are Diffracted or Reflected in Definite Patterns. These Enable the Analyst to Deduce the Arrangement of the Atoms Within the Crystals

WITHIN recent years the X rays have become an important link in the chain of researches on the constitution of matter. The atoms and molecules, with which these researches are mainly concerned, are far beyond the limits of observation of the finest microscope.

At the same time, the problem of the structure of crystals, having important bearings on the constitution of matter, has offered such difficulty, that heretofore it has received less attention than other branches of science.

The whole subject, however, has gained greater interest, from the discovery that X rays could be diffracted by means of crystals. This discovery, made by Friedrich and Knipping at the suggestion of Laue, established the fact that X rays were in reality light of a wavelength about 10,000 times shorter than that of visible light. A wide field of investigation was thus suggested, and physicists have since done much work on the determination of the arrangement of atoms within crystals or powders, and in the measurement of the wavelengths of X rays.

Using Atoms for Mirrors

In the application of Laue's suggestion, made by Friedrich and Knipping, a thin pencil of "white" X rays (that is mixed X rays of a number of different wavelengths) was passed through a crystal plate, and a photographic plate, placed a short distance beyond the crystal, recorded the reflected pencils as a number of regularly disposed dots. (Figure 1 shows the arrangement of the apparatus).

A recent example of a Laue crystallogram is shown in Figure 2, in which benzil was used as the diffracting object. From this and other photographs, certain symmetry relations of the crystal may be deduced.

The Vindication of a Theory

In 1912, Laue, an Austrian scientist, suddenly conceived a brilliant idea, notable for its utter simplicity. "Why not use the atoms within crystals as a diffraction grating for X rays," he asked, "just as we now use glass plates ruled with 20,000 parallel, diamond-cut lines per inch as diffraction gratings for light?"

Laue knew that X rays are identical in nature with ordinary light, except that their wavelength is 10,000 times shorter. Yet, to rule 10,000 × 20,000 parallel lines on glass would prove hopelessly out of the question. We cannot work that minutely.

But had not Nature already provided as good and as minutely spaced a grating as this would be, in the form of crystals? Mineralogists had said, on purely theoretical grounds, that the atoms of crystals were of a certain pattern and spacing, and that they were arranged in rows and tiers, like boxes packed into a room.

An experiment with crystals and X rays was quickly tried. It worked! Laue had reasoned right. The mineralogists had also theorized correctly. The X rays were seen to be diffracted by the atoms of the crystals in a beautiful, geometrical pattern. Despite the fact that no microscope has ever revealed an atom (so small are they), yet for most practical purposes we could now "see" them, because we could put them through certain performances and note the visible effects. It was like a blind man feeling out the contents of a room with a stick.

From these experiments we have learned much about X rays; also we have learned much about the actual structure of matter.

(In application, X-ray analysis is somewhat technical, yet it is extremely interesting and revealing. A notable work covering this subject is "The Structure of Crystals," by Ralph W. G. Wyckoff.)

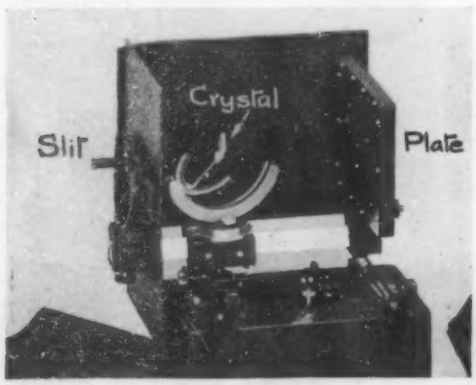
A brief explanation of the way in which the crystal structure affects the X rays may be given as follows: In one position (among many others) in the crystal, a number of atoms lie in a plane or "space-lattice." At a particular angle a pencil of rays reflected from the plane is retarded one wavelength behind a pencil reflected from an adjacent atom plane. In other words, the waves are "in step." The effect of this is that these pencils and others from parallel planes reinforce each other, and combine to form a beam sufficiently intense to form a dot on a photographic plate.

A little thought will show that there is more than one angle of reflection in which there is a wavelength retardation; also that there are other angles of reflection in which this condition is secured for X rays of other wavelengths. A further complication lies in the fact that the atoms in adjacent planes may be those of different elements with different spacings and different atomic weights. It is therefore difficult to deduce anything more than the fact that a simple crystal possesses certain properties of symmetry.

Improvement Quickly Followed

An improvement on Laue's method was made by W. H. and W. L. Bragg, who used a thin beam of "monochromatic" X rays (or X rays of only one wavelength) and obtained the reflection of this beam from selected atom planes of crystals. The reflection, although following the ordinary law that the incident and reflected angles are equal, has a perceptible intensity only when the vibrations in the beams reflected from a number of successive atom layers reinforce each other. In the direction where this is the case, a line is formed on the photographic plate.

In general, the X rays consist of a number of



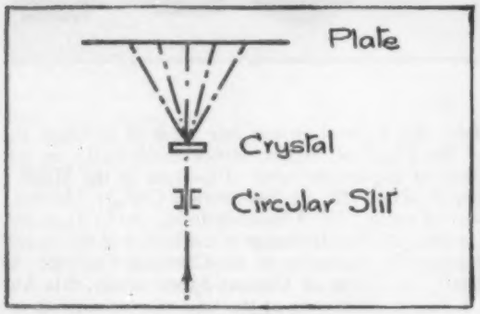
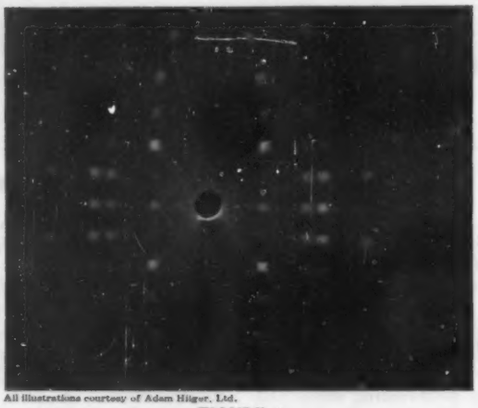


FIGURE 1

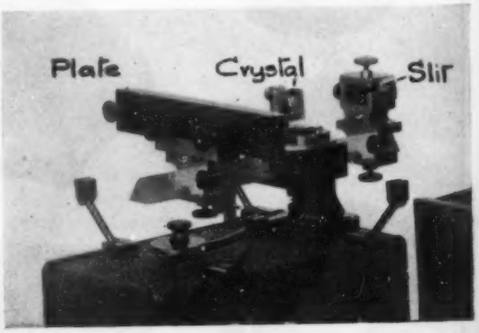
ABOVE: *Simple apparatus for crystal analysis.* BELOW: *A diagram of the apparatus shown immediately above*



All illustrations courtesy of Adam Hilger, Ltd.

FIGURE 2

A Laue crystallogram. The diffracted X rays produce dots in pattern on the photographic plate



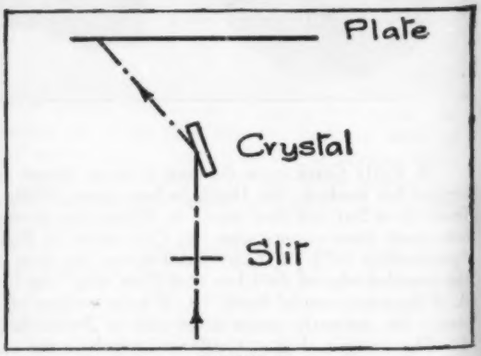


FIGURE 3

ABOVE: *Bragg's arrangement. Here the rays are reflected.* BELOW: *A diagram of the Bragg arrangement*

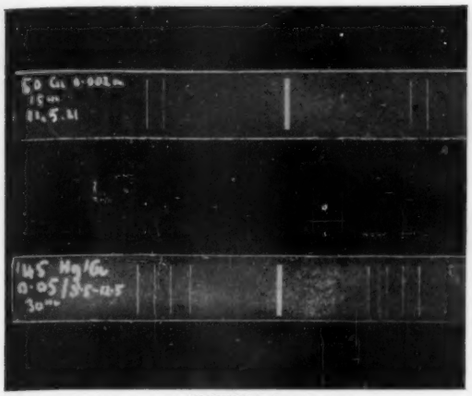


FIGURE 4

Two spectrograms made by the Bragg method. Each wavelength produces at least one line on the plate

different wavelengths, each of which gives at least one line on a suitably placed photographic plate. The whole series of lines constitutes an X-ray spectrum.

In Bragg's arrangement (shown in Figure 3) the X rays are passed through a narrow slit: they are then reflected from the crystal and recorded by the photographic plate. The crystal is oscillated through a given angle and at various orientations, the wavelength, atom plane spacings, and the glancing angle, are connected by a simple formula. At these points a line is recorded by the photographic plate, and the result is an X-ray spectrogram. Two examples of these spectra are shown in Figure 4.

The Powder Method

The very rapid advance made in the knowledge both of X rays and of crystal structure due to the introduction of the Bragg reflection method showed that the value of this method for investigating substances would be greatly increased if these substances were not needed in crystals of appreciable size. The necessary modification of the Bragg method was introduced independently by Debye and Scherrer, and by Hull, and consists of mounting the substance in powder form at the center of a cylindrical film. A pencil of monochromatic X rays falling upon a rod of such powdered crystal is reflected and photographed as a number of curved lines. The lines corresponding to all cleavage or atom planes are photographed at once and thus only one photograph is necessary. Figure 5 shows the arrangement, and Figure 6 shows two examples of Debye X-ray spectrograms taken on Dr. Muller's X-ray spectrograph.

In the case of Hull's method, a piece of paper is

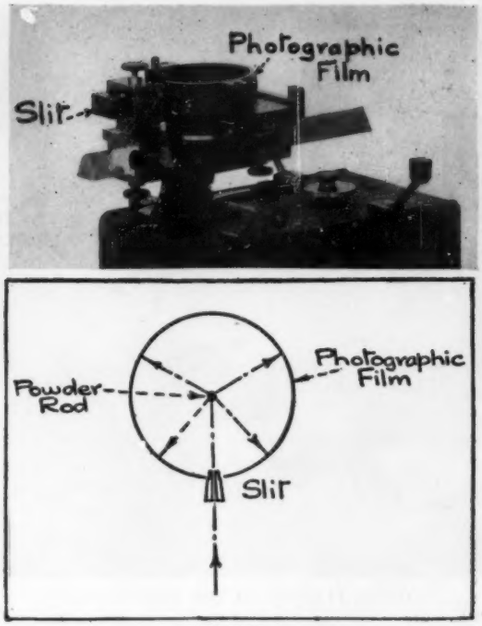


FIGURE 5

ABOVE: *Apparatus for the powder method.* BELOW: *A simple diagrammatic sketch of the apparatus shown above*

coated with a layer of powdered crystal and this is placed close to and across the opening of a thin channel through which the X rays pass. The thin beam of rays is reflected and lines are recorded on a flat photographic plate placed a short distance away.

In order that physicists may become familiar with one or more of these methods it is essential, in view of the depleted resources of most laboratories, that a comprehensive outfit, for a reasonable outlay, should be at their disposal. The X-ray spectrograph, designed by Dr. Muller working under Sir William Bragg at the Davy Faraday Laboratory, and made by Adam Hilger Ltd. (London), meets these requirements fully and enables all of the above methods to be used.

Figures 7, 8 and 9 show the spectrograph in operation, taking Bragg X-ray spectrograms.

Figure 7, shows the operator in the act of controlling the vacuum in the Shearer tube. Referring to the latter, this is a convenient means of producing X rays of the desired kind, and consists of a water-cooled vacuum tube, the vacuum being produced by suitable pumps. The necessary high voltage is secured by the use of high-tension transformers running on alternating current.

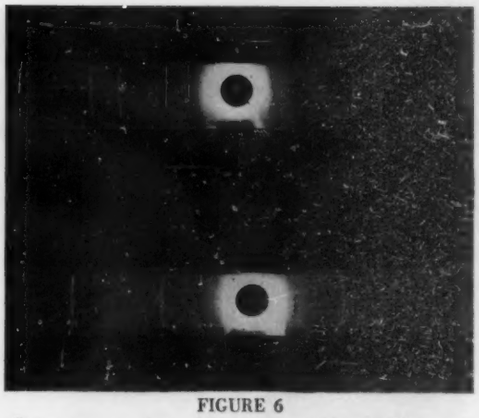


FIGURE 6

Spectrograms made by the powder method. The X rays are photographed in a number of curved lines

Figure 8 shows the instrument with the lead safety screen removed, and Figure 9 shows a clearer view of the Shearer tube.

Crystal analysis has also contributed to metallurgy to an invaluable extent. Dr. W. P. Davey of the research laboratory of the General Electric Company has demonstrated why different metals and different alloys of metals can have different properties.

Why Some Metals Are Brittle

A piece of metal is usually composed of small crystals irregularly arranged. It has been found, for example, that the ductile metals crystallize in a cubic arrangement, an atom being at each corner of the cubes. Brittle metals have a similar arrangement of the atoms, except that there is also one atom in the actual center of each cube. When these unit cubes are built up, thousands on top of thousands, lines of atoms are noticeable in several directions, just as in an orchard there are many directions in which the trees are in parallel rows. Extending these rows into the third dimension, similarly parallel planes are produced and it is on the arrangement of these planes that the qualities of the metals seem to depend.

"The structure of metals undergoes striking changes during the processes of preparation," says Edgar C. Bain, in *Industrial and Engineering Chemistry*. "Many manifestations of these changes may be followed by the microscope, but others are too subtle for this method of observation." Sometimes, continues this writer, these changes are due to atomic arrangement phenomena, and it is in this field that the study of X-ray diffraction of metals has proved a tool of research not incomparable with the metallurgical microscope in value to metallography.

FIGURE 7

How the operator controls the vacuum in the Shearer tube

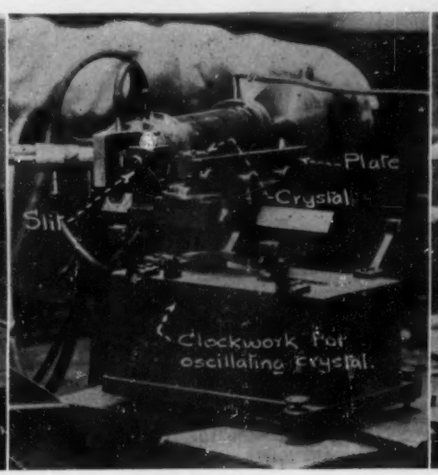


FIGURE 8

The same as Figure 7, with safety screen removed

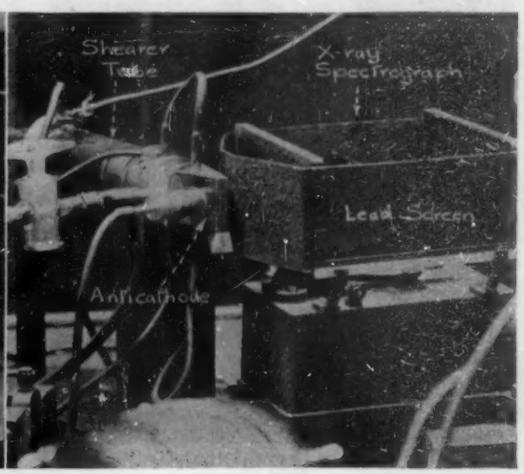
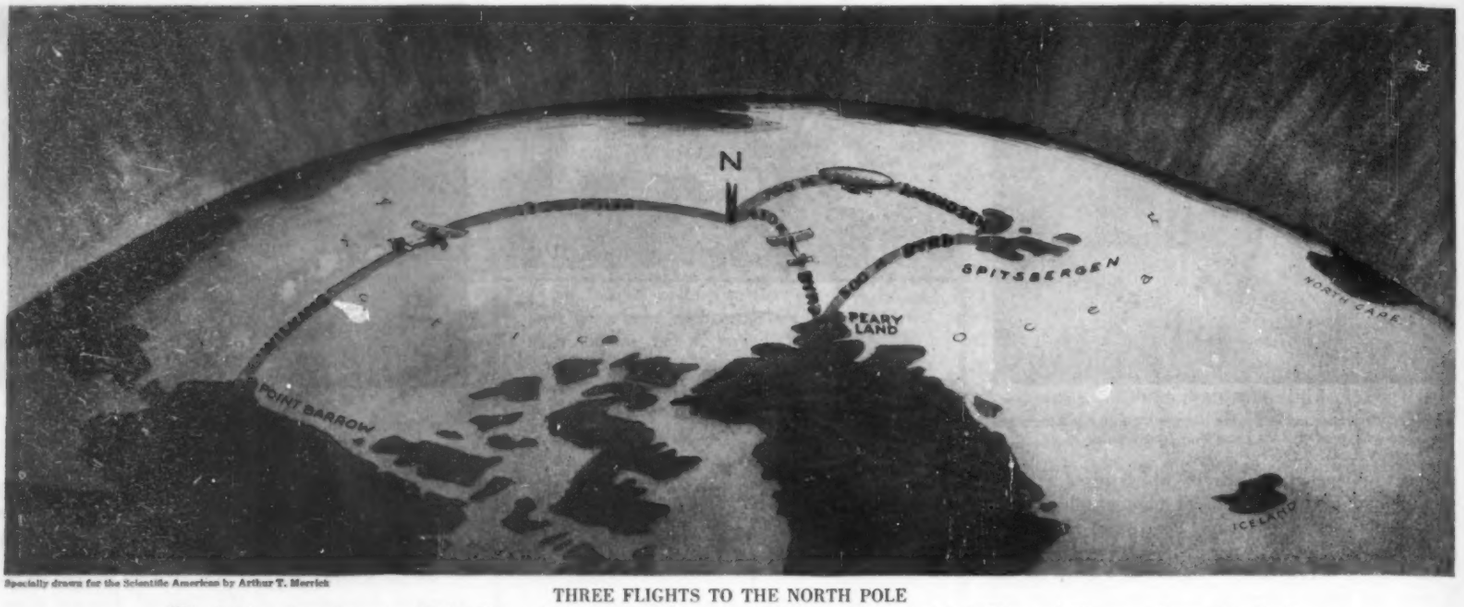


FIGURE 9

A clearer view of the Shearer tube than Figure 8 affords



Specially drawn for the Scientific American by Arthur T. Merrick

THREE FLIGHTS TO THE NORTH POLE

This drawing shows the routes which will be taken by the expeditions of Captain Amundsen, Captain Wilkins and Lieutenant Commander Byrd

Eavesdropping on the Arctic

Radio Fans Will Comb the Ether for Messages from the Aviator-explorers Racing to the Pole

By Orrin E. Dunlap, Jr.

THERE is no east, west or north at the top of the world and therefore thousands of short-wave radio receivers on all sides of the earth will have an equal opportunity to tune in the messages broadcast by the aviator-explorers participating in the race to the North Pole this summer. The etherial channels originating in the ice-capped region will be sprayed across the globe in much the same fashion as the lines of longitude radiate from the end of the earth's axis and spread out over the surface of the sphere.

Twelve arctic expeditions are in preparation and three are ready to hop off from northern points of land into the cradle of storms. All plan to use radio because of MacMillan's success in communicating with civilization last year while nestled in the ice packs off Greenland. Newspaper reporters, accompanied by radio operators and wireless equipment, have established a base at Point Barrow, Alaska, from where they hope to pick up and then relay the greatest news story of the year. It is expected that many amateurs operating short-wave sets will hear the narrative first hand from the explorers within a fraction of a second after the words are released into the northern air, because low wavelengths skip over short distances and travel far.

Wide World

CAPTAIN ROALD AMUNDSEN

The Amundsen-Ellsworth transpolar flight expedition has a route from Rome to Nome, via Spitsbergen

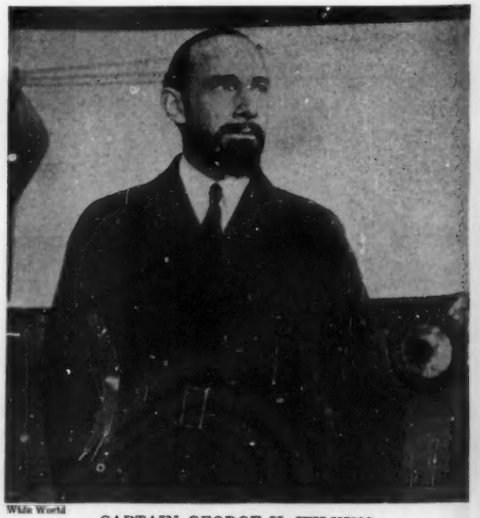
Wide World

LIEUTENANT COMMANDER RICHARD E. BYRD

He expects to keep in communication with the world on the 13-meter channel and auxiliary wavelengths. He will use the call letters KEGK, assigned to the S.S. Chantier

Lieutenant Commander Richard E. Byrd, leader of the flying expedition financed by American citizens among them John D. Rockefeller, Jr., and Edsel Ford, each contributing $20,000, expects to keep in communication with the world on the 13-meter channel and other auxiliary wavelengths. The wireless operators are L. K. Grenlie of Chicago and G. H. James of Manchester, Massachusetts, both former corporals in the Marine Corps. They will use the call letters KEGK assigned to the *S.S. Chantier*, the Shipping Board's steamer, fitted for work in icy seas and capable of carrying fuel sufficient for the planes to fly 10,000 miles.

Byrd's first flight will be from Spitsbergen to Cape Morris Jesup, Peary Land, North Greenland, the most northerly known land just 450 miles from the North Pole. There the base will be established so that the airmen can have a ready supply of gaso-



Wide World

CAPTAIN GEORGE H. WILKINS

His base is at Point Barrow, Alaska. He plans, if land is discovered, to make a non-stop dash for Spitsbergen

line and food. Two trips will probably be made to carry the supplies from King's Bay to Peary Land, a distance of 450 miles.

Owners of short-wave receivers are likely to hear dispatches radiated from the North Greenland base on the 13, 20, 40 and 80-meter channels. The Naval Radio Research Laboratory at Bellevue, D. C., and the Marine Corps at Quantico, Virginia, have built special equipment to detect the 13-meter signals because many of the amateur circuits are not designed to tune much below 20 meters. Use of the 13-meter channel was stimulated by the record of Dr. A. Hoyt Taylor of the United States Navy in sending messages across the United States to Oakland, California, in daylight on the 13.1-meter wave with a transmitter output of 250 watts.

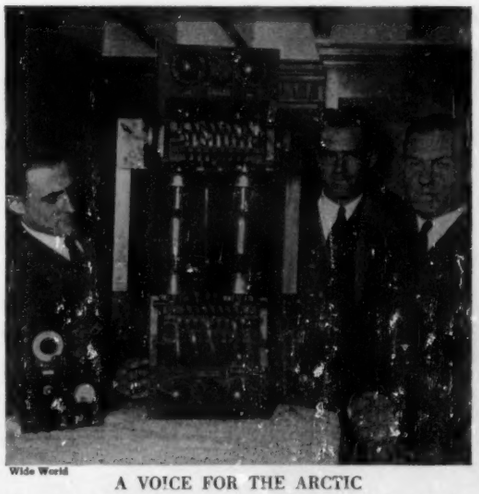
Commander Byrd expects to exchange weather and news with navy, amateur and experimental stations on all sides of the world. The steamer *Chantier* carries a 1-kilowatt navy spark installation, capable of broadcasting on 300, 600 and 800 meters, also a special short-wave, one-quarter-kilowatt, vacuum-tube transmitter operating on 500-cycle current. Naval engineers estimate that the short-wave set will cover twenty times as far as the *Chantier's* spark.

The receiving equipment consists of one navy standard circuit, designed for ship-to-ship communication and long-wave reception from the high-power transatlantic stations and from Arlington, Virginia, also two short-wave sets and two broadcast receivers for reception of entertainment.

Radio Will Play Important Role

The plane's transmitter will consist of one 50-watt vacuum tube and associate apparatus equipped with a piezo crystal to insure a constant frequency despite the vibration and movement of the airship. It will be tuned to broadcast on 61 and 44 meters covering a range estimated to be approximately 1,000 miles. The plane will also carry a portable short-wave receiver for use in case of forced landing. The generator is wind-driven but by means of a special gearing it can be cranked by hand. In case of an emergency landing, kites will be used to hold the antenna aloft and incidentally to serve as marking streamers.

Before leaving the United States in April, Byrd pointed out that radio would add an element of drama to the polar contest because he expects to maintain communication with Wilkins and his companions who are approaching the goal from Alaska and with Amundsen's dirigible sailing up from the European side of the globe. He said that they hoped to receive each other's messages and in case of distress one may be able to aid the other.



Wide World

A VOICE FOR THE ARCTIC

Short-wave transmitter on board the Chantier, *Commander Byrd's ship. Malcolm Hansen, designer of the set, is at the left, operators G. H. James and L. K. Grenlie at the right*

Commander Byrd's airplane transmitter was designed by Malcolm P. Hansen of the Navy and is similar to the one carried on the expedition of Captain George H. Wilkins, the Australian explorer who is backed by the American Geographical Society, the Detroit Aviation Society and the North American Newspaper Alliance. Captain Wilkins will also use the air in an attempt to discover unknown territory which is thought to exist in the region north of Alaska and Siberia.

The Wilkins' base has been established at Point Barrow, Alaska. He plans to wing his way in a Fokker plane across Beaufort Sea toward the Pole and, if land is discovered, a non-stop dash for Spitsbergen, a distance of 1,747 miles, may be attempted. It is 2,600 miles from Point Barrow to the Pole and back. If the trip is successful, the short waves radiated by Captain Wilkins' operator will tell the world what the veritable hub of the universe looks like from the air.

The Amundsen-Ellsworth transpolar flight expedition has a route from Rome to Nome via Spitsbergen in the *Norge*, a 400-cubic-foot semi-dirigible designed by an Italian, Signor Nobile, who will command the craft. There are eighteen in the party, including Raold Amundsen, discoverer of the South Pole and Lincoln Ellsworth, the American who flew into the arctic with the Norwegian explorer last year, only to be turned back when within 292 miles of their goal—the North Pole. This expedition is sponsored by the Aero Club of Norway and the Italian Government. Amundsen explained that the aim of his expedition is to obtain greater geographical knowledge, which radio waves will probably carry south as the big ship sails over the barren wastes in the north.

Captain Amundsen said that he hoped to be able to radio reports of the *Norge's* progress at every degree of latitude, giving the world, "an exciting narrative for at least 65 hours." The existing wireless stations at Nome and Kotzebue Sound will be kept busy handling the traffic from the north and in maintaining watches for SOS calls in case some of the aircraft drop to the icy surface and are unable to find a smooth run-way to hop off again into the sky.

Captain Berger Gothwaldt, radio expert on the *Norge* hopes to talk with American and European stations all the way by means of the Marconi set designed to cover a radius of 1,000 to 2,000 miles. In preliminary tests the receiver picked up many of the large European stations and proved its worth as a direction finder. The high-power station at Stavanger, Norway, answering to the call LCM, will broadcast on regular schedules, weather reports gathered from the northern regions of Canada, Russia, Siberia, Alaska and Norway.

Other Expeditions Going

Another expedition headed by Lieutenant Leigh Wade, an American around-the-world flyer, assisted by Lieutenant H. H. Ogden, another aviator who encircled the earth, supported by the alumni of several colleges will strive to make a round trip to the top of the globe this summer. Five Douglas planes will be employed in this attempt, which has been organized by Robert A. Pope.

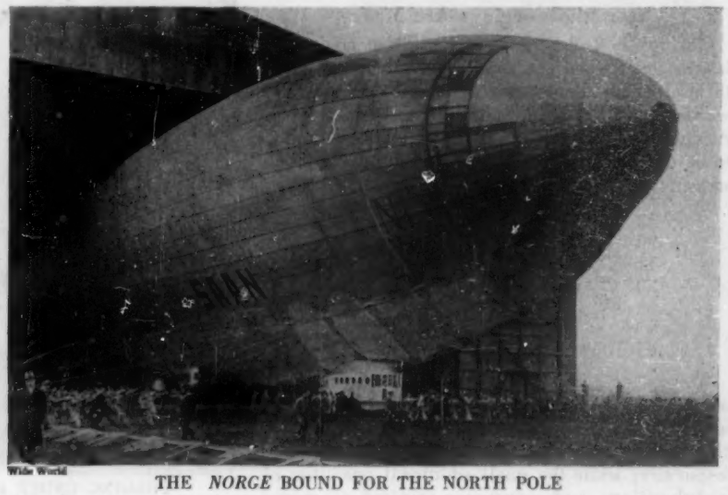
Those who have short-wave apparatus tuned in on the north will also have an opportunity to pick up news from the following expeditions which will get under way later than those already mentioned: Robert A. Bartlett Expedition, equipped with airplanes and with the North Pole as an objective; the French Polar Flight led by Captain Jules de Paver to take off from Francis Joseph Land for a trip to the Pole; the Swedish-Hammer Polar Flight; the British-Norwegian expedition captained by Colonel Tryggve Gram; the Soviet Polar Flight in the airship *Lenin;* MacMillan's expedition to find more evidence of the Norseman's visit to Laborador; an expedition led by Harrison Williams and backed by the American Museum of Natural History and George P. Putnam, which will cruise the seas around Greenland in search of scientific data.

The main object of all flyers will be to reach the Pole and explore parts of the 1,000,000 square miles of "lost continent" known as "Area X."

Wide World

COMMANDER BYRD'S GIANT FOKKER PLANE

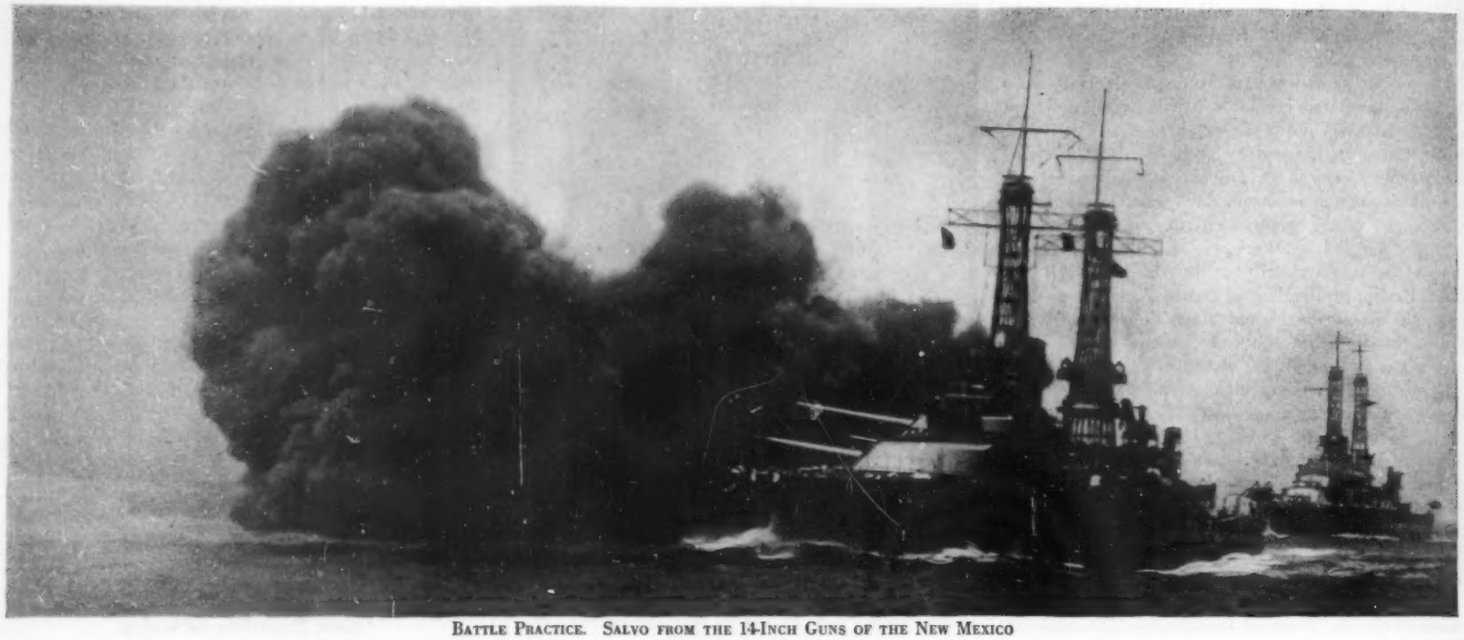
Operators of short-wave sets are likely to hear the messages which will be sent from this plane when it flies over the arctic regions



Wide World

THE *NORGE* BOUND FOR THE NORTH POLE

Amundsen hopes to broadcast messages at every degree of latitude, giving radio fans an exciting narrative for at least 65 hours



BATTLE PRACTICE. SALVO FROM THE 14-INCH GUNS OF THE NEW MEXICO

The Manufacture of a Battleship's Turret Guns

From the Molten Steel in the Furnace to the Finished Gun on the Ship

By Lieut. Comdr. W. H. P. Blandy, United States Navy

THE turret guns of our battleships—those powerful and ponderous weapons which throw tons of steel across miles of space with marvelous accuracy—are highly worthy specimens of the steelmaker's and machinist's arts. The finest grade of steel obtainable in large forgings goes into their thick walls, and probably nowhere is such precision demanded in heavy machine work as is required in turning and boring their various layers. For these giant rifles are not made from a single mass of steel, as might be supposed from the brief glimpse occasionally afforded in the "News Weeklies" at the movies. They are built up of numerous layers of forged steel, each assembled upon the next inner member with just the right pressure at the contact surface to afford proper support, without causing undue strain in any part, when the terrific firing pressure is developed in the bore.

How the Forgings Are Made

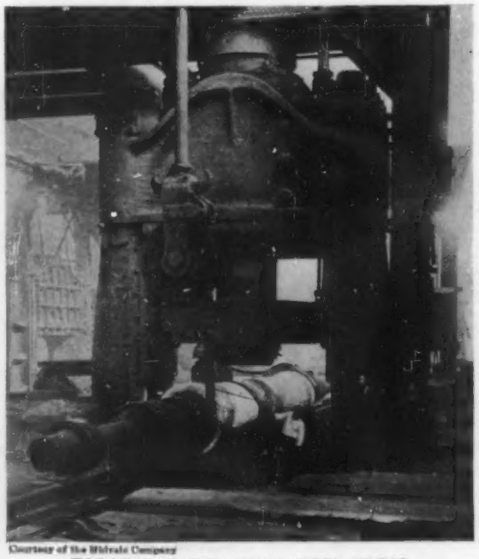
The rough steel forgings are made of acid open-hearth steel. The component materials used must themselves be almost entirely free from impurities which would cause defects in the finished forging. A typical furnace "charge" for a nickel steel "hoop" to be used on a 14-inch gun is as follows, in rough measure:

13	Tons	Nickel Steel Scrap
20	"	Low Phosphorous Pig Iron
11	"	Nickel Steel Turnings
20	"	Steel Plate
1	"	Metallic Nickel
65	Tons—Total Charge	

These constituents are loaded into the furnace and about nine hours are necessary for melting, and about six more for refining. Iron ore is added to the molten bath to assist in oxidizing the carbon and impurities; while the small additional quantities of nickel, silicon, and manganese required are added as the "heat" progresses. If the carbon gets too low, spiegel or pig iron is added to recarburize. Chemical tests of small specimens drawn from the bath toward the end of the heat show exactly whether the correct proportions of all elements are being obtained; and when such is finally the case, the burners are shut off for about 20 minutes to allow the molten metal to cool in the furnace to the pouring temperature. This period also allows slag particles and gas to rise to the surface.

The molten metal is now poured into the ingot mold. Then, when the ingot has cooled to such a degree that the outside is solid and firm, the mold is stripped from the ingot, and the latter buried in ashes to insure slow cooling.

The next step, after the metal has been cast in the form of an ingot, is forging. The ingot is heated in a furnace to a white heat. It is then carried to a forge press, and the top and bottom "discard" (containing impurities) is sliced off. The remainder is now set upright and "upset" by the press until its length is greatly reduced. A die is then punched down through the center of the ingot, making it hollow. You begin to see possibilities of that white spongy mass becoming part of a gun after all.



Courtesy of the Midvale Company

FORGING UNDER HYDRAULIC PRESS

The white-hot forging is slipped over a mandrel and forged down to shape in this 9,000-ton press

A long, cylindrical mandrel is now thrust through the central hole in the ingot; and as the white-hot steel is repeatedly pressed by the forging die, and the mandrel is revolved, the metal works out along the mandrel until the forging has been transposed from a short squat cylinder of great wall-thickness, into a very long tube with a comparatively thin wall. The process of forging also closes up all "pipes" and "blowholes" in the steel as cast, breaks up the coarse crystallization, increases the cohesion of the crystals, and produces a silky, fibrous structure.

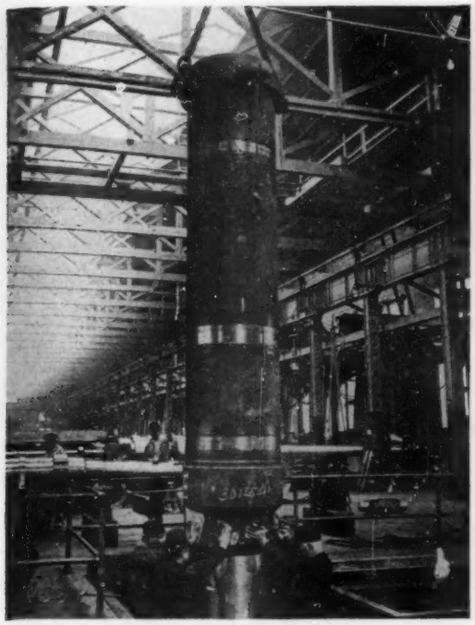
Fourteen Forgings for One Gun

The forging is now "annealed" to remove forging strains, and to complete the work of grain refinement. This process consists in slowly heating the forging to a definite temperature, holding it at that temperature for several hours, and slowly cooling it in the closed furnace.

The annealed and comparatively soft forging is now rough-machined. In its annealed condition, the steel does not possess sufficient strength, so it must receive a further heat treatment. It is heated in a vertical furnace to a white heat, and then plunged into a quenching bath of cool water—a most inspiring sight, which should not be missed by anyone who has the opportunity to witness it.

After the quench comes a "draw" in a horizontal furnace. This process greatly resembles annealing, but the temperature reached is much lower. Its purpose is to relieve quenching strains, temper the hardness to a degree permitting easier machining, and remove brittleness.

Specimens are now cut from the forging for phys-



LOWERING THE JACKET

The heated jacket, contracting upon the cold tube, holds it in a powerful grip. This greatly increases the resistance of the tube to the powder pressure

ical test. The testing machine measures the elastic strength (reached just before distortion occurs), the ultimate breaking strength, and the ductility. If these tests are satisfactory—and visual inspection discloses no defects—the forging is accepted provisionally by the Navy's inspector, and is delivered to the Naval Gun Factory at Washington, D. C. Assuming now that a complete set of forgings has been received at the Gun Factory, the work of building up the gun commences. The magnitude of this part of the job may be appreciated from the fact that 14 separate forgings have to be assembled to make one 16-inch gun.

The innermost cylinder is the "liner" in which the rifling is engraved. It exists for economy's sake; for when the rifling becomes worn, the gun may be made just as good as new by replacing the old liner with a new one, and then rifling the new liner.

But since the liner is very thin, it adds but little to the strength of the gun. It is therefore always the last member to join the family. Next outside the liner is the tube which, like the liner, runs the full length of the gun. Over the tube the jacket is shrunk on. The dimensions of the tube and jacket must be such that the outer diameter of the tube is larger by a few thousandths of an inch than the inner diameter of the jacket. The exact difference is called the "shrinkage." This is one of the most exact machine jobs performed anywhere on "big work," since the finished shrinkage surface must not vary by more than half the thickness of a cigarette paper.

The jacket is now heated in an electric furnace until large enough to pass freely over the tube, which has been placed breech downward in the "shrinking pit." The expanded jacket is lowered over the muzzle end of the tube, in the bore of which cold water is circulated to keep it from heating up and expanding.

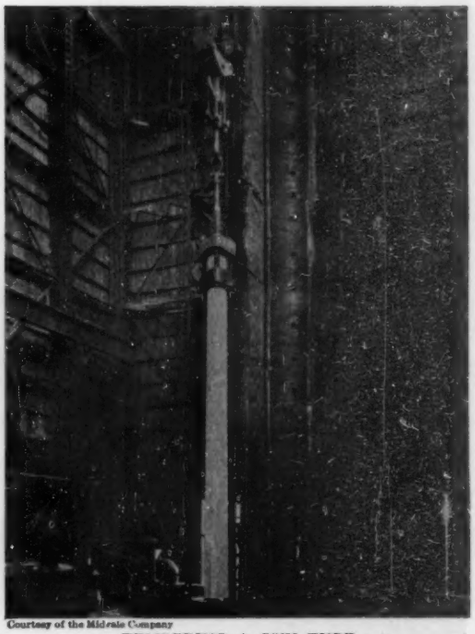
Shrinking Strengthens the Gun

As the jacket cools, it grips the tube until the tube is under compression and the jacket in tension. This combination enables the tube to withstand a higher powder pressure. In a thick-walled cylinder like a gun, an internal pressure makes its presence felt much more upon the metal near the bore than upon that near the outer surface. Hence, if the inner metal is initially *compressed*, it can stand a certain amount of internal pressure before it even *begins* to be *stretched*.

The other cylinders are shrunk on the assembled tube and jacket in the manner described for these two, and finally the whole gun, minus the liner, is placed muzzle downward in the pit, heated in place, and the cold liner lowered into it.

When the gun now cools, the work of assembling is finished. It is next "finish-bored" with the greatest accuracy possible—the only remaining machine work being to cut the rifling grooves. The "rifling head" is a cylinder carrying a number of cutting tools equally spaced around its periphery. It is fixed to the end of a long cylindrical bar, which is made to rotate as the rifling head is forced into the gun. The result is that the cutters engrave spiral grooves in the bore.

There remains only to attach the "breech mechanism," which has been undergoing its manufacture in a separate shop. This important part of the gun consists principally of a large block of steel, weighing nearly a ton for the larger guns, which is swung on hinges at the breech. When swung into its closed position, this heavy block screws into the breech and seals it against a powder pressure of sometimes more than 20 tons per square inch. In spite of the rather intricate mechanism involved, and the great weight of the breech-block, however, the opening and closing of the breech are done in the winking of an eyelid.



Courtesy of the Midvale Company

TEMPERING A GUN TUBE

The tube is raised to white heat in the lofty cylindrical furnace, seen back of the tube. It is then tempered by being lowered into a tank of oil

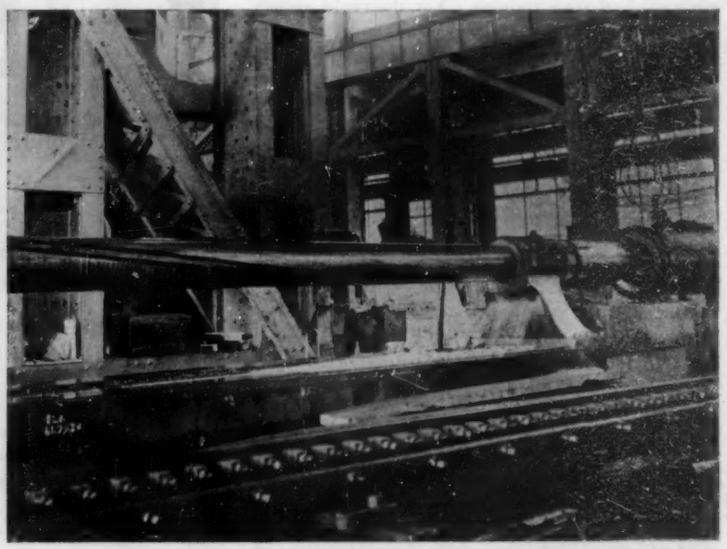
Although not a part of the manufacture, the final process necessary to the acceptance of the finished gun is its "proof." Several shots are fired from it, including at least one with an overcharge of powder, to prove that it can fire ordinary "service" charges on board ship, with perfect safety.

The tried and true defender is now placed on a barge or a railroad truck and started on the journey which carries it eventually to its floating home. There, housed in a grim gray turret, it maintains a silent watch over the nation's destinies, except for a few brief remarks made each year, more or less in jest. And if the occasion arises when it must speak in deadly earnest, rest assured that the word will be exactly to the point, and full of meaning.

Courtesy of the Midvale Company

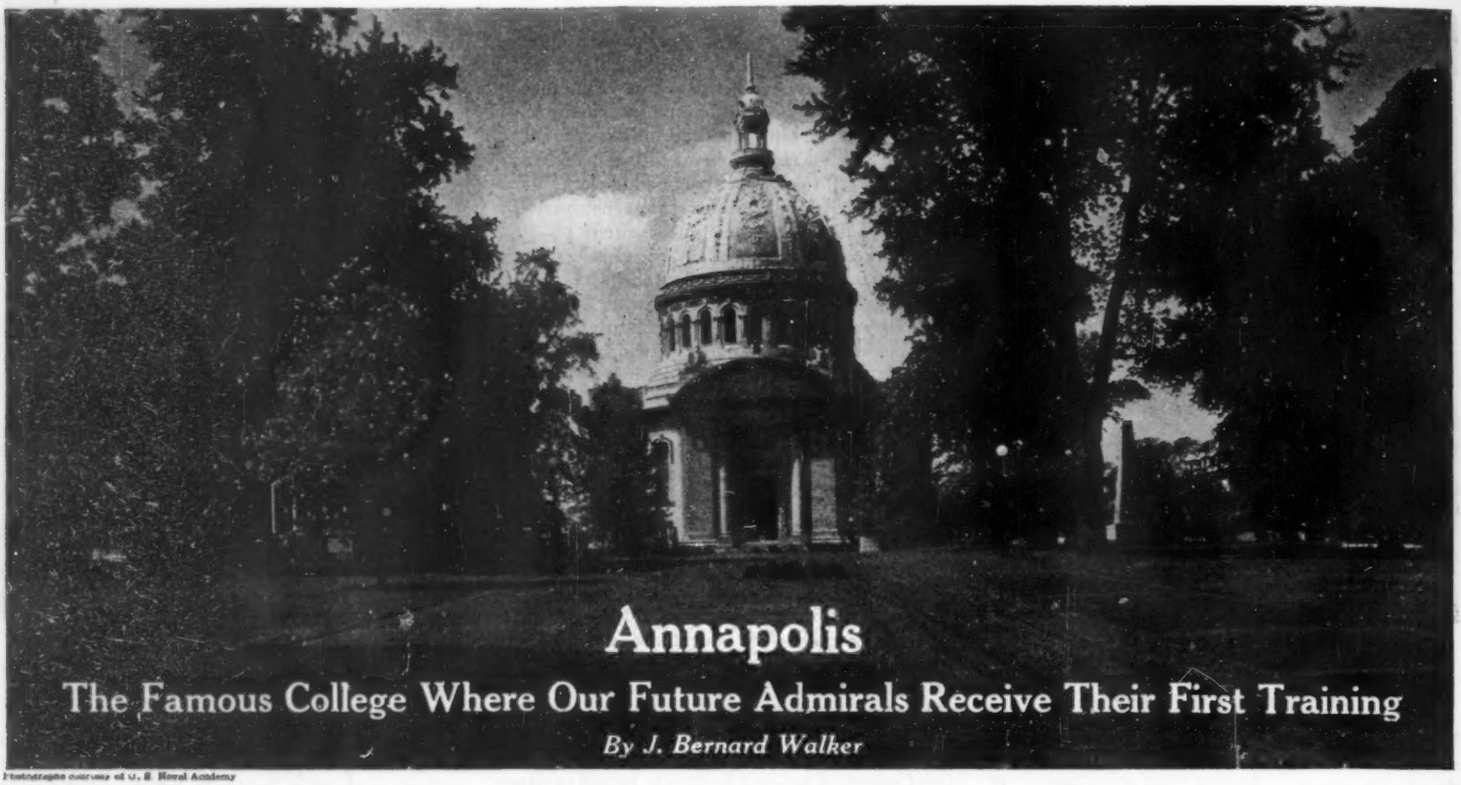
POURING THE INGOTS

When the steel has been refined in the furnace, it is tapped into a large ladle, carried over the ingot molds, and poured through a hole in the bottom



RIFLING THE GUN

The rifling machine cuts a series of equally spaced grooves in the tube. These serve to spin the projectile and maintain it unerringly on its true course



Annapolis

The Famous College Where Our Future Admirals Receive Their First Training

By J. Bernard Walker

Photographs courtesy of U. S. Naval Academy

ANNAPOLIS, like its famous sister college, West Point, has the advantage of a fine scenic setting. Although it has not the background of forest and mountains which lends such charm to the military school on the Hudson, Annapolis has a beauty of environment which is all its own. Behind it nestles a lovely centuries-old town, with its many wonderful, red-brick colonial mansions. Before it the broad expanse of the Chesapeake gives the proper marine touch to the picture, while the long sweep of its lovely greensward, with its wonderful growth of stately timber serves to give an instant impression of dignity and very real beauty as one passes the entrance gates.

Except as regards the site and its rich traditions, the Annapolis that we see today is not the Annapolis in which the admirals and older ranking officers of our navy had their training. For the rapid growth of our navy since the Spanish War, and the corresponding increase in the number of midshipmen, called for a great enlargement of the accommodations and necessitated making a rather complete sweep of the older structures to make way for the vast and very impressive buildings in which the present academy is housed. Whatever sentimental regret we may feel at the change, it cannot be denied that the whole scheme of the new buildings has been carried out on a scale of dignity and convenience which renders Annapolis well worthy of the great navy which it serves.

Founding of Annapolis in 1845

In former days such famous sailors as Farragut began their sea training at the early age of ten—not in such an elaborate institution as we now see at Annapolis, but on board ship and under the tutelage of an officer who acted as sponsor for the young midshipman's training. "This practical schooling among the 'rough necks'—the flotsam and jetsam of the water fronts of big cities—produced some of the best officers and some of the finest traditions of the naval service; but such an environment for very young boys, while it was the making of the large majority, unmade countless others. Only very unusual characters could stand such a training." It was these conditions that led George Bancroft, the historian, when he was Secretary of the Navy, to found a school on shore for the training of boys for officers of the navy. Bancroft selected Annapolis as the site of his school and thus became the founder,

MAIN ENTRANCE TO BANCROFT HALL

This magnificent building which, with its connecting wings, has a total facade of over 1,400 feet, contains living accommodations for 2,500 midshipmen

in 1845, of the United States Naval Academy. The new Academy covers some 300 acres, much of it consisting of magnificent lawns, which are surrounded and shaded by many ancient trees. Around these wide-spreading lawns are picturesquely grouped in an architectural unit the vast granite and white-faced brick buildings, the athletic field and drill grounds, and the long stretch of the water front.

What is the aim and purpose of Annapolis? Broadly speaking, it is three-fold. In the first place, it is a college whose curriculum is more thorough, broader and more exacting than that of any four-year graduation course at any civilian college. There can be no denying that the midshipman who applies himself earnestly to the mastering of the course, leaves Annapolis with a broad and very thorough education. But it is the aim of Annapolis to do something more than give its inmates a thorough education; for it seeks to inspire these young men, to saturate them, with the finest traditions of the United States Navy, and to this end both within the grounds and in the various great halls of the institution is to be found an amazingly rich collection of relics of our navy, dating from its very earliest beginnings.

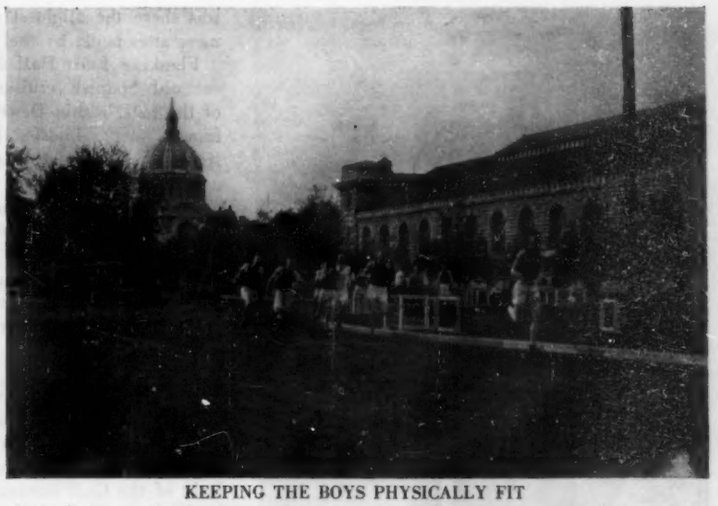
In the Chapel Sleeps John Paul Jones

In the crypt below the college chapel rests the body of John Paul Jones, who with good reason has been called "the father of our navy." And as one wanders through the grounds and passes through hall after hall of the buildings, he finds himself face to face with endless evidence in the way of statues, busts, oil portraits, autographed letters, famous historical sayings, tattered flags, captured cannon and a thousand other mementoes, which constitute in themselves a comprehensive history of the great sea captains and the major engagements of our navy from colonial days down to the great war.

But while we give full credit to the scholastic and traditional influences of Annapolis in the molding of these young men into the material out of which our future officers will be developed, there is one other, and perhaps the greatest, goal of all at which the sponsors of Annapolis continually aim, and that is to saturate the students with what we might call the spirit of Annapolis, to instil within them such a regard for veracity, honor, self-sacrifice and dignified patriotism, that these qualities will become, with each and every one of them, a second nature. More perfectly put, Annapolis aims to make every student a gentleman of the type which can be instantly recognized, whether you meet its representative in a presi-

AIRPLANE VIEW OF THE ACADEMY

In foreground, Bancroft Hall with Dahlgren Hall to the left and Macdonough Hall to the right. Beyond are the Chapel and the Academic Group



KEEPING THE BOYS PHYSICALLY FIT

Annapolis insures that its students shall possess "a sound mind in a sound body." All forms of athletics are encouraged. Here is a contest on the running track

dent, a captain of industry, an admiral, a mechanic, or in the humblest tiller of the soil.

The broad mission of the naval academy has been officially defined as follows:

"To mold the material received into educated gentlemen, thoroughly indoctrinated with honor, uprightness and truth, with practical rather than academic minds, with thorough loyalty to country, with a ground work of educational fundamentals upon which experience afloat may build the finished naval officer, capable of upholding, whenever and wherever may be necessary, the honor of the United States; and withal giving due consideration that healthy minds in healthy bodies are necessities for the fulfillment of the individual missions of the graduates; and that fullest efficiency under this mission can only be attained if, through humane yet firm and just discipline, the graduates carry into the Service respect and admiration for this Academy."

It may be possible for some people to get a fair impression of Annapolis by making a tour of the grounds and buildings within the space of one day; but it would take two, or better, three days, for the visitor to grasp the full significance of this great institution. What time he might have left after doing justice to the wealth of material—architectural, historical, and so forth, in the Academy—he could spend very delightfully and profitably among the stately colonial mansions and in the venerable Court House of Annapolis itself, not failing in the last-named building, to visit the charming old colonial room in which George Washington resigned his commission.

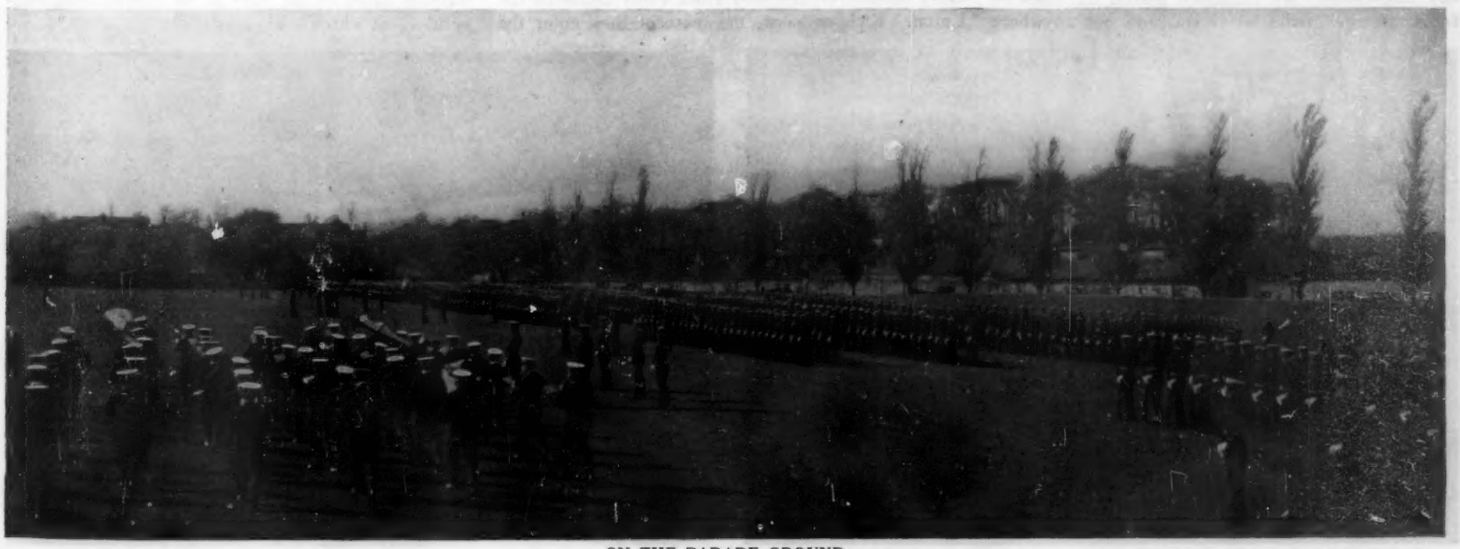
Entering by the main avenue gate of the Academy (Maryland Avenue), and turning to the right, the visitor passes the Administration Building and then comes upon the stately pile of the chapel, with its handsome bronze doors and golden dome. Entering the crypt, which will be reminiscent of that of Napoleon, at the Invalides, Paris, he will see the handsome marble sarcophagus of John Paul Jones, his service sword, and his bust by Houdon. To the American Ambassador, Horace Porter, a great debt is owing for his successsful search, which ended in the finding of the body of Jones in an old, forgotten cemetery in Paris and his bringing it back to the United States, with fitting pomp and ceremony, to its present appropriate resting place in the Academy grounds.

The Imposing Pile of Bancroft Hall

Continuing to the right, one passes the imposing Superintendent's House, and beyond and somewhat back of this he will see a long row of white-brick residences, the quarters of the heads of the Academy. Then, at right angles to these, he will be filled with wonderment by the imposing facade of Bancroft Hall, measuring in over-all length some 640 feet, which, with its two great wings, is capable of housing 2,500 midshipmen. As he faces the main entrance he will notice several large buildings which flank Bancroft Hall on either side. To the right is Dahlgren Hall, a vast structure, formerly known as the Armory and named after the inventor of the first large-calibre naval guns. Both outside and within this hall are objects of deep interest in ordnance and gunnery; and in the gallery upstairs will be found a fascinating collection of naval relics, including a fine collection of photographs of spectacular features of the recent World War. The great floor space is large enough for a whole regiment at drill; and it is here that the President of the United States hands out every year the diplomas, after which august ceremony, it is not unusual for some 10,000 people to gather at the "Farewell Ball."

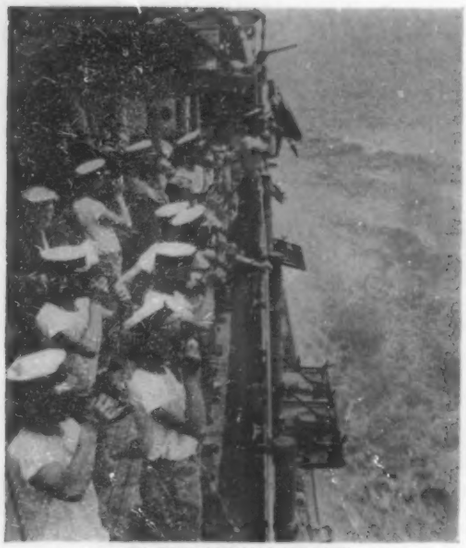
Flanking Bancroft Hall on the other side are the Natatorium, containing the largest indoor tiled pool in the United States, measuring 60 by 100 feet; and beyond that, connected by a colonnade, is the gymnasium, named Macdonough Hall, after the victor in the Battle of Plattsburgh, in the War of 1812. Here he may look on two 24-pounders from the enemy's flagship, *Confiance*, captured at Plattsburgh. A notable object is the huge 50-foot model of the *Antietam* under full canvas.

Beyond Macdonough Hall is the Seamanship Building, known as Luce Hall, after Rear Admiral Stephen



ON THE PARADE GROUND

No one who visits Annapolis should miss the dress parade of the whole regiment of 2,000 midshipmen on the parade ground



ON THE ANNUAL CRUISE

Long summer cruises at sea form part of the curriculum. Here is a navigation class using the sextant

B. Luce, founder of the War College at Newport, R. I. Here are housed the departments and the classrooms of Navigation and Modern Languages.

Bancroft Hall, the central feature of this great group, is a stupendous building, covering 20 acres, containing three miles of corridors, and capable of accommodating 2,500 midshipmen. Entering the central door and passing up the stairway, one enters Memorial Hall, and on the opposite wall notices Perry's battle flag at Lake Erie, with the words of Lawrence upon it, "Don't give up the ship." Memorial Hall is enriched with portraits of naval officers from the earliest down to the present days of our naval history. Passing across the hall, one obtains, through the windows, fine views of Farragut Field, the drill and football grounds, with the harbor and bay in the distance. On the floor below is Recreation Hall, the midshipmen's lounging room, and below this are the huge mess hall and kitchen. This mess hall is one of the most spectacular features of the Academy. Imagine a dining room over 523 feet long and 74 feet wide, with the plates, knives, forks, et cetera, set out with exact military precision, for 2,500 midshipmen. Then picture these splendid young men, spick and span, entering the hall and seating themselves with all the precision of a field day inspection. We examined plates, the tines of forks, glasses, chairs, et cetera, and not anywhere was there the slightest sign of dust or dirt. The mess attendants, by the way, are all Filipinos.

Flanking Luce Hall is Santee Basin, containing the old Spanish cruiser *Mercedes;* and in front of the hall, within Dewey Basin, is the hull of that famous yacht, *America,* looking as smart and clean-lined as when she was launched some 75 years ago. Under shelter in the Basin are the various ship boats in which the midshipmen are trained, and moored along the full length of the Basin is a fine fleet of sailing cutters, in which the midshipmen are regularly trained in boat sailing. At the far end of the green and facing Bancroft Hall are the Academic Buildings, arranged on three sides of a square.

The Academic Group of Buildings

The right wing is Maury Hall, named after that famous naval officer who gave to the world accurate charts of trade winds, ocean currents, and particularly of the Gulf stream. Here are the classrooms in Mathematics and English, and in the basement a small museum with a most interesting collection of Americana which no visitor can afford to miss. The central building, Mahan Hall, named after our foremost naval strategist and historian, contains upstairs the very handsome library, and on the main floor, the auditorium. This building is rich in historical flags, including those from the battle of Manila Bay, a unique collection of Naval Academy flags and some 40 British flags captured in the War of 1812, including those of the *Guerierre* and the *Java* captured by our most famous ship, *Old Ironsides,* for whose rebuilding contributions are being solicited from the American people, with a request that they be sent to "Save the Constitution" Fund, Charleston Navy Yard, Boston. The left wing of the academic group is called Sampson Hall, after Rear Admiral Sampson, victor at Santiago. Here are the classrooms and the laboratories of the Department of Electrical Engineering and the Department of Physics.

Immediately behind Mahan Hall is Isherwood Hall, named after our foremost marine engineer of the Civil War. To any visitor of an engineering turn of mind, this will prove to be a most fascinating building, and a half day could be spent here to good advantage. The collection both of models and full size marine engine boilers, ships, dry docks, et cetera, is superb.

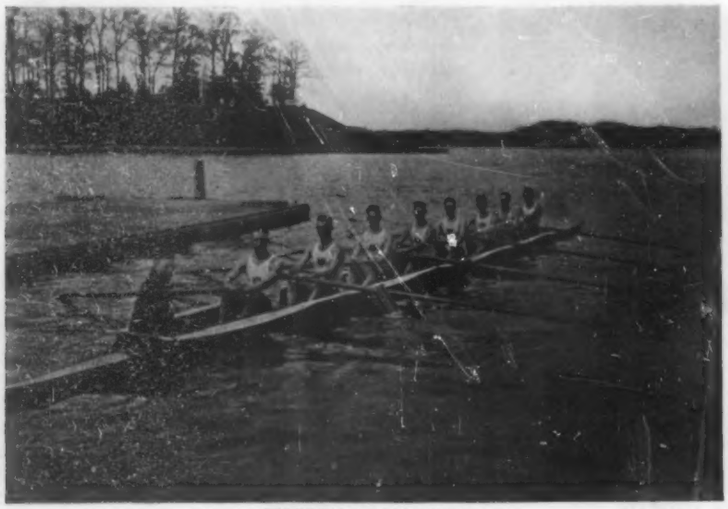
The Academy students may be regarded as a cross-section of the youth of America. They come from every station of life and from every State in the Union. Rich or poor, the moment they enter the

BEARING THE COLORS

The colors are borne by the company which joins the annual inter-company competition in drill

Academy gates, they fall into the general level of the most perfect democracy ever devised by man. The students are called midshipmen. Five are allowed for each Senator, Representative and Delegate in Congress; and the President appoints five for the District of Columbia and 15 each year from the United States at large. Also, the law authorizes the appointment of 100 enlisted men each year, to be selected by competitive examination. The age at admission must lie between 16 and 20. One midshipman is allowed from Porto Rico, and four are delegated by the Governor-General of the Philippine Islands. The course for [illegible] shipmen is four years. During the summer, midshipmen of the first, second and third classes go to sea for about three months. After graduation, the midshipmen are commissioned as ensigns in the Navy. The candidates must be of good moral character, physically sound, well formed and of robust constitution.

Limitations of space prevent our doing more than merely touch upon the question of physical training. This is, of course, very thorough and includes, naturally, a broad and quite extensive course in the leading sports. The results of robust constitution, fine physique, wholesome living, hard training and strict discipline are shown year by year by the high standing taken by the Navy in the international competitions in which it engages.

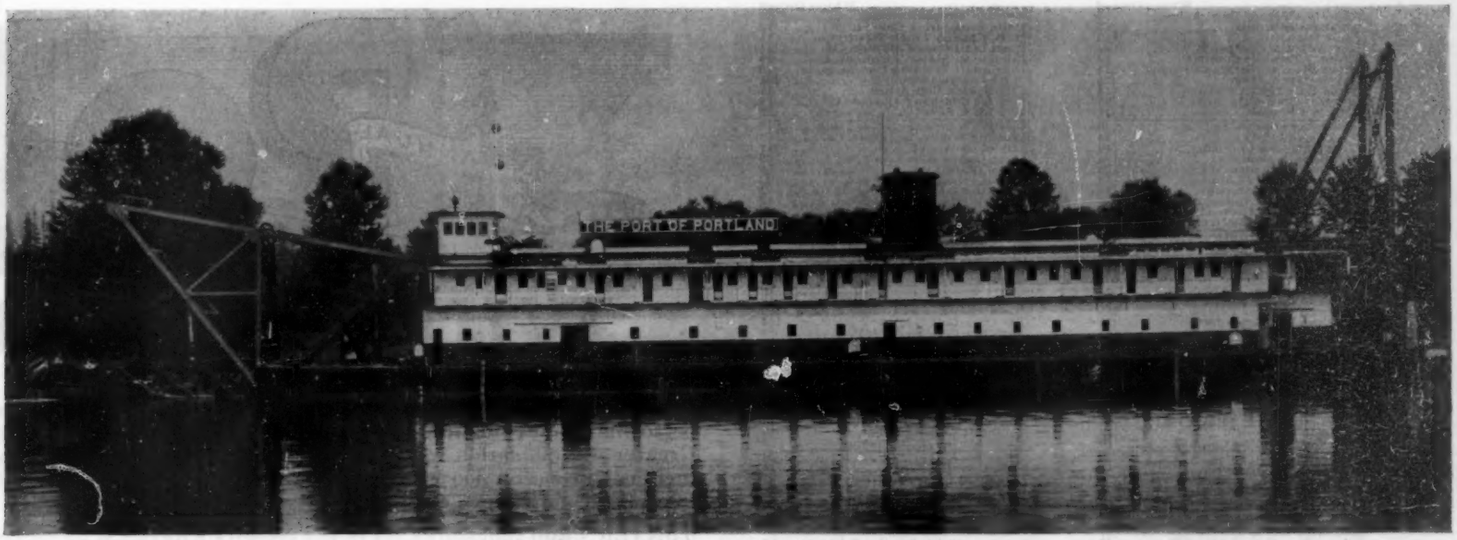


WORLD'S CHAMPIONS

The navy crew that won the Olympic Championship for eight-oared crews in 1923

GUN DRILL

Here is a class in ordnance, drilling with a 5-inch, torpedo-defense gun



POWERFUL, DIESEL-ELECTRIC DREDGE *CLACKAMAS*

Length, 236 feet; beam, 50 feet; depth, 12 feet 9 inches; displacement, 2,480 tons; horsepower, 3,400

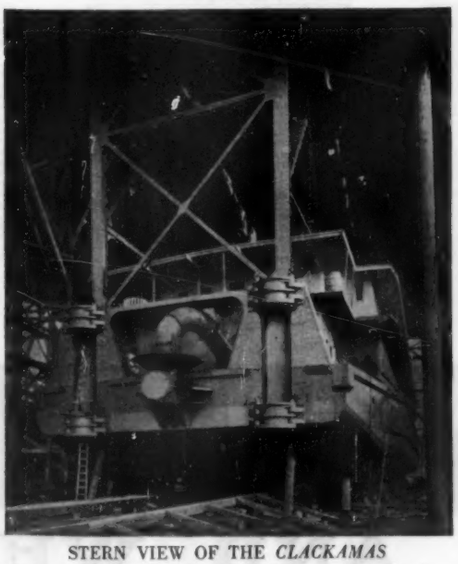
Oil Engine in a New Field

Performance of Powerful Diesel-Electric Dredge, Port of Portland

THE City of Portland, Oregon, situated on the Willamette River, has grown so rapidly that it has become necessary to straighten the channel of the river and to increase the city's dockage facilities for shipping. The dredging plant of the city has recently been augmented by the construction of a steel dredge of great size and unusual strength, which is equipped with Diesel engines and a delivery pipe thirty inches in diameter.

The *Clackamas*, as she is called, was designed by James H. Polhemus, General Manager and Chief Engineer of the Port of Portland, to whom we are indebted for the following particulars: The steel hull, which is 236 feet long by 50 feet beam and 12 feet, 9 inches deep, has a displacement of 2,480 tons at a draft of 7 feet, 9 inches.

Particular attention was paid to the design of the hull to enable it to carry its heavy Diesel engine equipment, and to minimize the damage in case of collision. There are two longitudinal watertight bulkheads, 7 feet inboard, which are intersected by traverse bulkheads and provide six watertight compartments on each side of the hull. The hull space between the longitudinal bulkheads is also divided into six watertight compartments. In addition to these, there is a heavy frame 4 feet, 2 inches deep tied to each panel point of the trusses, extending to the longitudinal bulkheads and the side of the hull, with additional deep frames, 6 feet apart, tied to the longitudinal bulkheads. These bulkheads greatly strengthen the dredge.



STERN VIEW OF THE *CLACKAMAS*

The hinged pockets for the steel spuds, 35 inches in diameter by 80 feet long

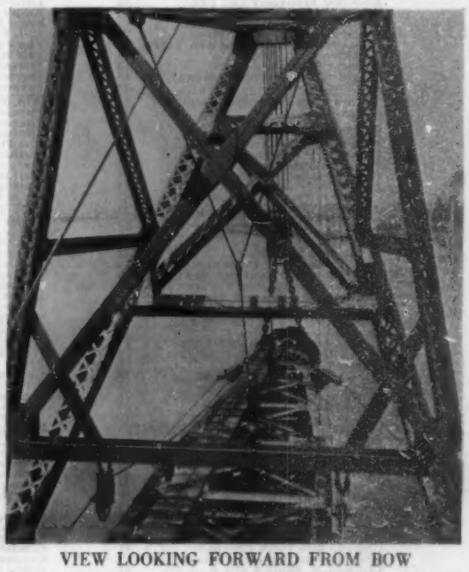
There is a heavy bridge-type double steel truss throughout the full length of the hull, the forward end being extended to form the A frame for the ladder hoist, the spud masts aft being tied into and forming a part of this truss. Forward of the deckhouse the top members of the trusses converge, meeting the forward member of the A frame 32 feet forward of the bow. At this location a structural steel frame is formed carrying five sheaves for the ladder hoist tackle, the lower one of which is a quadruple sheave block chained to the digging ladder near the outer end. The spuds are 35 inches in diameter and 80 feet long, constructed of three-quarter inch steel plates rolled into a cylindrical tube, and they are provided with cast-steel conical points at the bottom. The spud wells, in which the spuds slide, consist of heavy, cast-steel, hinged keepers which enable the spuds to be removed.

The main installation consists of two 800-horsepower Diesel engines, stationary type, each directly connected to a 540-kilowatt, direct current generator, and two 900-horsepower, marine-type, Diesel engines, each connected to a 610-kilowatt direct current generator. The combined power is 3,400 brake horsepower, and the consumption is 4¼ barrels of oil per hour (full power). It is possible to stop one unit for repairs and still obtain about 80 percent efficiency with the remaining three. In the electric main drive are two 610-kilowatt 500-volt direct current generators and two 540-kilowatt 500-volt generators with a 50-kilowatt auxiliary generator. The cutter is driven by a 250-horsepower motor. There is a 75-horsepower motor for the forward swing drive hoist, a 45-horsepower motor, each, for the forward ladder hoist and the stern hoist, and a 60-kilowatt generator for lighting and auxiliary power.

The dredging pump is a high-speed, square, volute-lined centrifugal type pump developed by the Port of Portland, having 30-inch suction and discharge opening.

The main pump motor is a 2,700-horsepower machine directly connected to the pump; and it is the largest of its kind ever built for dredging.

The *Clackamas* has proved its superiority over steam equipment of the same general type. In three calendar days, the new dredge handled 43,700 cubic yards through a discharge pipe 7,590 feet long, moving sand, clay, gravel and sticks with a terminal lift of 29.3 feet. The average discharge for the three days was 797 cubic yards per hour. This was done without the aid of an electric booster. In comparison with the work of the *Clackamas*, the steam turbine dredge *Tualatin* through a discharge line 5,944 feet in length and with a terminal lift of 29.2 feet, an average of 571 cubic yards per hour; but the latter dredge required the assistance of an electric booster.



VIEW LOOKING FORWARD FROM BOW

The forward end of a heavy steel truss forms the A frame for the ladder hoist

	Whites Owned
Abbotts Alderney Dairies, Inc.	55
Abraham & Straus	67
Acme Cash Stores	18
J. N. Adam & Company	41
Advance Transfer Company	14
Aguas Blancas Nitrate Company	11
City of Akron, Ohio	26
Akron Pure Milk Company	18
Alabama Coca-Cola Bottling Co.	15
Alabam's Freight Service	11
Albers Brothers Milling Co.	10
Allegheny County	13
Alms & Doepke Company	10
B. Altmas & Company	94
American Agricultural Chem. Co.	28
American Bakery Company	15
American Can Company	84
American Chain Company	13
American Fruit Grow ers, Inc.	10
American Gas & Electric Co.	30
American Ice Company	28
American Motor Tours Co.	15
American News Company	30
American Oil Company	12
American Petroleum Company	37
*American Power & Light Co.	42
American Public Service Co.	16
American Railway Express Co.	585
American Red Cross Society	31
American Reduction Company	11
American Relief Admin. (Russia)	21
American Steel & Wire Co.	37
American Stores Company	136
American Tobacco Company	11
*American Water Wks. & Elec. Co.	16
American Woolen Company	31
A. L. Ammen Trans. Co.	48
*Anaconda Copper Mining Co.	15
Anderson Brothers	17
Anglo-Mexican Pet. Co., Ltd.	10
Anheuser-Busch, Inc.	18
State of Arizona	12
Arlington Mills	18
Armour & Company	441
J. H. Ashdown Hardware Co., Ltd.	10
*Associated Bell Telephone Co.	1420
*Associated Dry Goods Corp.	11
Associated Gas & Electric Co.	11
Atheas Coca-Cola Bottling Co.	23
City of Atlanta	41
Atlanta Baggage & Cab Company	23
Atlanta Chero-Cola Bottling Co.	15
Atlanta Coca-Cola Bottling Co.	22
Atlantic Ice & Coal Corp	88
Atlantic Refining Company	945
Atlas Powder Company	23
Andrew Augustine	11
Austin, Nichols & Company	33
Ayer & McKinney	11
Bacon Coal Company	13
The Bailey Company	19
Baker Evans Ice Cream Co.	10
Bakersfield-Los. Ang. Fast Freight	24
City of Baltimore	46
L. Bamberger & Company	91
Bang Supply Company	16
Banner Grocers' Baking Company	14
N. Bantivoglio & Sons	11
Bardsleys Motors, Ltd.	27
Barker Brothers, Inc.	18
*Barnsdall Corporation	15
The Barrett Company	19
Beaver Valley Service Company	24
B. C. Motor Transportation, Ltd.	20
Beechnut Packing Company	16
Bekins Van & Storage Company	25
Belcher Asphalt Paving Company	10
Benguet Auto Line	10
Bentzinger-Leitzinger Stores, Inc.	16
Berwick Cake Company	11
Bessemer Taxi Company	19
Best & Company	30
William Bingham Company	27
Bingham Stage Line	11
Samuel Bingham's Sons Mfg. Co.	12
Birmingham Chero-Cola Bot. Co.	34
City of Birmingham	26
Bishop & Company	11
H. L. Black & Son	10
Block & Kuhl Company	16
Frank E. Block Company	11
Bloomingdale Brothers	41
Blue Ridge Transportation Co.	14
Bluff City Delivery Company	11
Boggs & Buhl, Inc.	27
The H. C. Bohack Company	17
The Borden Company	46
City of Boston	44
Boston Coca-Cola Bottling Co.	10
Boston Elevated Railway Co.	120
Boston & Maine Railroad	18
Botsum Brothers Company	15
Bourne-Fuller Company	14
George H. Bowman Company	10
Bowman Dairy Company	31
Brandies Stores	10
Bradford Baking Company	47
The Brandt Company	43
J. W. Brannon Sand & Gravel Co.	14
Braun Lumber Company	10
John Breuner Company	14
Brewster Transport Co., Ltd.	14
Bridgman & Russell Company	24
Brink's Express	14
Broadway Department Store	31
Brout Provision Corp. of New York	10
Brooklyn Daily Eagle	18
Brooks Oil Company	13
Bry-Block Mercantile Company	15
Buckeye Pipe Line Company	30
Buenos Aires Post Office Dept.	23
Bullock's	23
W. N. Burdine Sons	13
P. H. Butler Company	29
Byrne Bros. Construction Co.	42
Cable Draper Baking Co.	10
State of California	65
California Baking Company	21
California Nevada Stage Co.	24
California Packing Corporation	41
California Petroleum Company	27
California Transit Company	39
California Truck Company	21
L. H. Callan	15
J. Calvert's Sons	21
William Cameron Company, Inc.	16
R. O. Campbell Coal Company	16
The Campbell Baking Company	33
Canfield Oil Company	25
Canton Provision Company	13
Canton Storage & Transfer Co.	10
Capitol Garage	10
Carbon Coal Company	13
R. E. Carey Company	12
Carnegie Steel Company	10
Carolina Power & Light Co.	18
Carolina Public Service Co.	13
J. B. Carr Biscuit Company	11
Carroll Bros. Truck Service	24
Carstens Packing Company	11
Carter Oil Company	13
Casper Motor Bus Line	16
Central African Transp. Co.	11
Central Torpedo Company	12
Chandler & Rudd Company	11
Chase Meat Works	21
Cheek-Neal Coffee Company	19
Chero-Cola Bottling Companies	119
The Chero-Cola Company	57
City of Chicago	160
Chicago Amer. & Herald-Exam.	44
Chicago Fire Brick Company	21
Chicago Fire Insurance Board	11
Chicago, N. Shore & Mil. R. R. Co.	31
Chicago Surface Lines	13
Chicago Towel Company	22
Chile Exploration Company	12
H. B. Church Truck Service Co.	16
Cincinnati Coca-Cola Bot. Co.	11
Cincinnati Motor Terminals Co.	19
Cincinnati Traction Company	10
*Cities Service Company	121
City Baking Company	15
City Ice Company (Kansas City)	19
City Ice & Fuel Co. (Cincinnati)	22
City Ice & Fuel Co. (Cleveland)	19
Clearing House Par. Deliv. Co.	13
City of Cleveland	217
Cleve.-Ashta.-Conneaut Bus Co.	35
Cleve. Bldrs. Sup. & Brick Co.	93
The Cleveland Cartage Co.	22
Cleveland Elec. Illuminating Co.	72
Cleve.-Elyria-Toledo Bus Co.	12
The Cleveland Press	25
Cleveland Provision Company	35
Cleveland Railway Company	64
Cleveland Trans. & Cartage Co.	37
Cleveland Trinidad Paving Co.	14
Cleveland & Sandusky Brew. Co.	32
Cloverlands Dairy Products Co.	12
Cloverleaf Creamery Co.	10
Clover Meadow Creamery Co.	12
*Coca-Cola Bottling Companies	382
The Coca-Cola Company	104
The Coca-Cola Co., Ltd. (Canada)	70
Coca-Cola Bot. Wks. (Nashville)	12
W. I. Coldiron	10
J. C. Coleman & Son	11
Coleman & Clark	10
James E. Colliflower & Co.	10
Collins Hauling Company	22
Colonial Ice Cream Company	27
Colorado Coca-Cola Bottling Co.	11
Columbia Coca-Cola Bot. Co.	14
Columbia Ice & Ice Cream Co.	13
Columbia Stages	34
L. H. Colvin	10
Comar Oil Company	22
R. H. Comey Company	11
Comfort Coach Company, Ltd.	12
Commercial Oil Company	10
Commercial Transfer Company	14
Commonwealth Fuel Co., Inc.	58
Commonwealth Pr., Ry. & Lt. Co.	15
State of Connecticut	47
The Connecticut Company	39
Connecticut Motor Transp. Co.	16
Connecticut Pie Company	10
Conrad-Baisch-Kroehle Co.	18
Consolidated Companies	33
Consolidated Ice Company	11
Consolidated Motor Freight Lines	16
Consolidated Rendering Co.	46
Consumers Baking Company	20
*Consumers Bread Company	30
Consumers Dairy Company	23
Consumers Pie & Baking Co.	18
Continent Baking & Milling Co.	21
*Continental Baking Corp.	57
Continental Oil Company	140
Copper Range Motor Bus Co.	11
Coral Gables Corporation	47
Cottage Creamery Company	13
Walter J. Cox Company, Inc.	14
Crane Company	31
Crescent Forward. & Transp. Co.	19
Cuban Government	20
Cudahy Packing Company	35
John T. Cunningham	42
Cushman's Sons, Inc.	12
Cuyahoga County (Ohio)	17
Dahl-Campbell Grocery Co.	17
Dannemiller Grocery Company	10
Darling & Company	48
Thomas D'Attilio	20
Davies Supply Company	12
Davis Construction Company	18
Davison Cartage Company	12
The Dayton Company	13
Daytona Shores	10
De Haven Ice Cream Company	10
City and County of Denver	11
Denver Cab Company	40
Louis Dent Cogswell	13
Dill & Collins Company	11
Dixie Construction Company	23
Dominion Bridge Company, Ltd.	11
Drake Brothers	36
Drake Lay Yards, Inc.	16
Driscoll Trucking Company	22
Duke Power Company	13
E. I. Dupont De Nemours Pdr. Co.	16
Eagle Bottling Works	11
East Ohio Gas Company	20
East Side Mill & Lumber Co.	16
Eastern Torpedo Company	26
Eastman Kodak Company	13
Thomas W. Easton's Sons	21
T. Eaton Company, Ltd.	42
Eckenroth Sales Company	14
Abraham Eisenberg Co., Inc.	11
Ejercito de Chile	15
*Electric Bond & Share Co.	50
Elete Company	88
G. T. Elliott	12
Emerick Motor Bus Company	10
Emerson & Morgan Coal Co., Inc.	10
Empson Gas & Fuel Company	10
Ernst Fuel & Supply Company	12
A. J. Evans	21
The Fair	12
Fair Haven Coal Company	10
Fairmont Creamery Company	55
Farrar-Carlin & Granfield	10
Fayette Baking Company	15
Wm. Filene's Sons Company	16
Firestone Tire & Rubber Co.	113
Fischer Baking Company	21
Fischer Lime & Cement Co.	11
The Fleischmann Company	23
Fleisher Transfer Company	10
State of Florida	23
Florida Coca-Cola Bottling Co.	20
Florida Motors Line, Inc.	27
Fly & Hobson Company	14
C. H. Foley	20
Foster & Kleiser, Inc.	24
Frank & Seder	40
Franklin Ice Cream Company	31
Harry V. Franks	23
Frederick & Nelson, Inc.	23
William Freihofer Baking Co.	54
Frischkorn Florida Company	10
Fujiya Hotel Garage	11
Fuller Cleaning Company	16
W. P. Fuller & Company	32
Fullington Auto Bus Company	13
County of Fulton, Ga.	11
G. H. P. Cigar Company	11
Frank Gaffney	15
Galena Signal Oil Company	15
Garfield-Passaic Transit Co.	18
Gellfuss Bakery	12
General Baking Companies	241
*General Electric Company	45
General Fire Extinguisher Co.	16
General Gas & Electric Corp.	18
*General Ice Cream Company	10
General Linen Sup. & Ldry. Co.	28
General Petroleum Corporation	105
General Stores Corporation	13
Georgia Railway & Power Co.	76
Gerkins Oil Company	13
Gilmore Oil Company	13
Gimbel Brothers, Inc. (Milwaukee)	12
Gimbel Brothers, Inc. (N. Y.)	92
Gimbel Brothers, Inc. (Phila.)	91
Glacier Park Transportation Co.	61
Globe Bottling & Sales Co.	11
Globe Grain & Milling Co.	28

WHITE FLEETS of

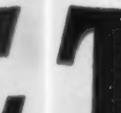
The annual White Roll Call again! It is the industry's most convincing performance document. . . . Greater fleets. . . . Greater total of fleets. . . . Greater diversification of fleets. . . . Greater evidence of the consistently increasing earning power of White Trucks and White Busses—all models, in all lines of business, everywhere.

This year's Roll Call shows 961 of the country's foremost owners operating 35,755 Whites *in fleets of ten or more* . . . . 124 more owners than last year . . . . 4,662 more Whites.

Imposing as this total is—35,755 Whites in Roll Call fleets—it represents less than half the Whites in service. Tens of thousands of additional owners operate fleets of less than ten, or single Whites. There are more Whites in service than trucks or busses of any other high-grade make.

Each line in this record represents a business success. Great, growing institutions invest millions in additional Whites year after year. They

	Whites Owned
City of Gloucester	15
Gloucester Auto Bus Company	18
Adolf Gobel, Inc.	50
Goeringer Construction Co.	11
Goff-Kirby Company	18
Golden Sheaf-Remar Baking Co.	19
Golden State Auto Tours Corp.	12
Goldenrod Ice Cream Co.	27
J. Goldsmith & Sons Company	11
B. F. Goodrich Company	10
Goodyear Tire & Rubber Co.	23
Gordon & Harrison	10
Grasselli Chemical Company	15
Gray Construction Company	31
Grays Harbor R., L. & P. Co.	15
The Great Atlan. & Pac. Tea Co.	17
Great Northern Paper Co.	29
Great Southern Refining Co.	11
Greenfield Elec. L. & P. Co.	20
Greif Brothers Cooperage Co.	42
Gridley Dairy Company	18
Gulf Coast Motor Lines	10
Gulf Pipe Line Company	14
Gulf Production Company	16
Gulf Refining Company	1929
Gypsy Oil Company	37
H. F. Hadan	13
Hadley Furniture & Carpet Co.	28
Hahne & Company	49
Haile Brothers Company	21
Hammond Lumber Company	13
W. T. Hardison & Company	11
The Hardware & Supply Co.	10
Harman-Hull	13
Hartford Electric Light Co.	13
Hartman Furniture & Carpet Co.	22
Fred Harvey	31
C. F. Hathaway & Son	15
Hauser Packing Company	17
Haverty Furniture Company	30
Hawaii County, T. H.	19
Hawaiian Pineapple Co., Ltd.	29
The Hecht Company	36
H. J. Heinz Company	83
Heissler & Junge Company	18
Hercules Powder Company	23
Peter Herkner Trucking Co.	12
Hershey Creamery Company	14
Hess Brothers	11
Heywood-Wakefield Company	11
Hialeah-Allapatta Bus Line	18
The Higbee Company	23
Hildebrandt Provision Co.	29
F. H. Hill Company	12
H. G. Hill Grocery Company	22
Hitchner Biscuit Company	11
Hochschild, Kohn & Company	37
H. B. Hoie	17
Holland Bread Company	73
*Hollywood Land & Water Co. (Fla.)	90
Hong Kong Hotel Co., Ltd.	11
Honolulu Const. & Dray. Co., Ltd.	15
H. P. Hood & Son	19
Hope Natural Gas Company	27
Joseph Horne Company	50
Houston Lighting & Power Co.	12
Huasteca Petroleum Company	38
The Hub (Baltimore)	11
J. L. Hudson Company	58
Hudson's Bay Company	26
Hughes-Curry Packing Company	11
H. B. Hughes Truck Company	21
Humble Oil & Refining Co.	60
Hutzler Brothers Company	10
Ice Delivery Corp. (Norfolk)	11
State of Idaho	30
State of Illinois	61
Illinois Power & Light Corp.	23
Imperial Ice Cream Company	23
Imperial Oil, Ltd.	121
Independent Brewing Co. of Pitts.	53
Ind. School Districts (Minn.)	30
Independent Torpedo Company	21
Independent Towel Supply Co.	31
Indian Automobile Co., Ltd.	12
Indian Refining Company	11
State of Indiana	43
International Petroleum Co.	22
International Petroleum Co., Ltd.	48
Interstate Public Service Co.	18
Interstate Wholesale Grocers, Inc.	27
Interurban Transportation Co.	11
Iowa State Highway Com.	32
Iron City Sand Company	13
Iron Range Transportation Co.	15
County of Jackson (Missouri)	14
A. Jackson & Sons	10
Jackson Brewing Company	10
Jahncke Service, Inc.	18
Oswald Jaeger Baking Company	10
Jefferson County Boards (Ala.)	51
Jessup & Antrim Ice Cream Co.	11
Johnson Bus Lines, Inc.	10
Johnson Oil Refining Co.	10
Jones Store Company	33
Julian Petroleum Corporation	22
Jump Housewrecking Company	14
S. Kann Son's Company	20
Kansas City Power & Light Co.	12
Kansas Gas & Electric Company	26
Kaufmann & Baer Company	58
Keiser Transportation Co., Inc.	14
Kellogg & Ferner	12
Kennicott-Patterson Transfer Co.	11
C. D. Kenny Company	66
J. Kenny Transfer Company	18
State of Kentucky	39
Kern County (California)	32
King County (Washington)	24
Kingan & Company	57
Kinney & Levan Company	11
The Kirk Company	12
B. B. & R. Knight, Inc.	12
E. H. Koester Bakery	20
Charles Kuppinger	10
Lackawanna Laundry Company	17
Laclede Gas Light Company	13
Lake County (Indiana)	11
J. M. Landers	
Lansburg & Brothe	
Lantro Nitrate Corp	
La Salle & Koch Co	
Jacob Laub Baking Co	
Laundry Trucking Company	
C. Lewis Lavine	
A. Leach & Company	
J. William Lee & Sh	
Fred T. Ley & Compa	
Leyte Land Transportation Co.	
Liberty Baking Company	
Lightning Delivery Company	
Lilly White Gasoline Company	
Lincoln Fireproof Storage Co.	
Lind Transfer Company	
Liquid Carbonic Company	
Lit Brothers, Inc.	
Livingston Baking Company	
Frederick Loeser & Company	
Loft, Inc.	
Log Cabin Baking Company	
Long-Bell Lumber Company	
Long's Transfer Company	
J. F. Loomis Coal & Supply Co.	
Loose-Wiles Biscuit Company	
City of Los Angeles	
County of Los Angeles	
Los Angeles Brewing Company	
Los Angeles Creamery Company	
Los Angeles Gas & Elec. Corp.	
Los Angeles Ice & Cold Stor. Co.	
Los Angeles Railway Corp.	
Louisiana Coca-Cola Bottling Co.	
Louisville Railway Company	
City of Lowell (Mass.)	
Alexander Lurie	
Lutter Brick Company	
M. L. W. Truck Company	
R. H. Macy & Company	
Magnolia Petroleum Company	
Mahoney Lumber Co.	
Mandel Brothers	
Manhattan Oil Company	
City of Manila, P. I.	
Marin Transportation Company	
Maritima de Cons. y Trans. Cia.	
Marland Refining Company	
Maryland State Roads Com.	
State of Massachusetts	
Massachusetts Baking Company	
Massachusetts Lighting Co.	
George Matthews	
May, Stern & Company	
The May Company (Cleveland)	
The May Company (Los Angeles)	
McCreery & Company	
McCutcheon-Chappell Company	
McGowan Brothers Company	
G. M. McKelvey Company	
McMahon Transportation Co.	
McQuesten & Lewis	
L. G. Mead	
Wm. J. Meehan & Brother	



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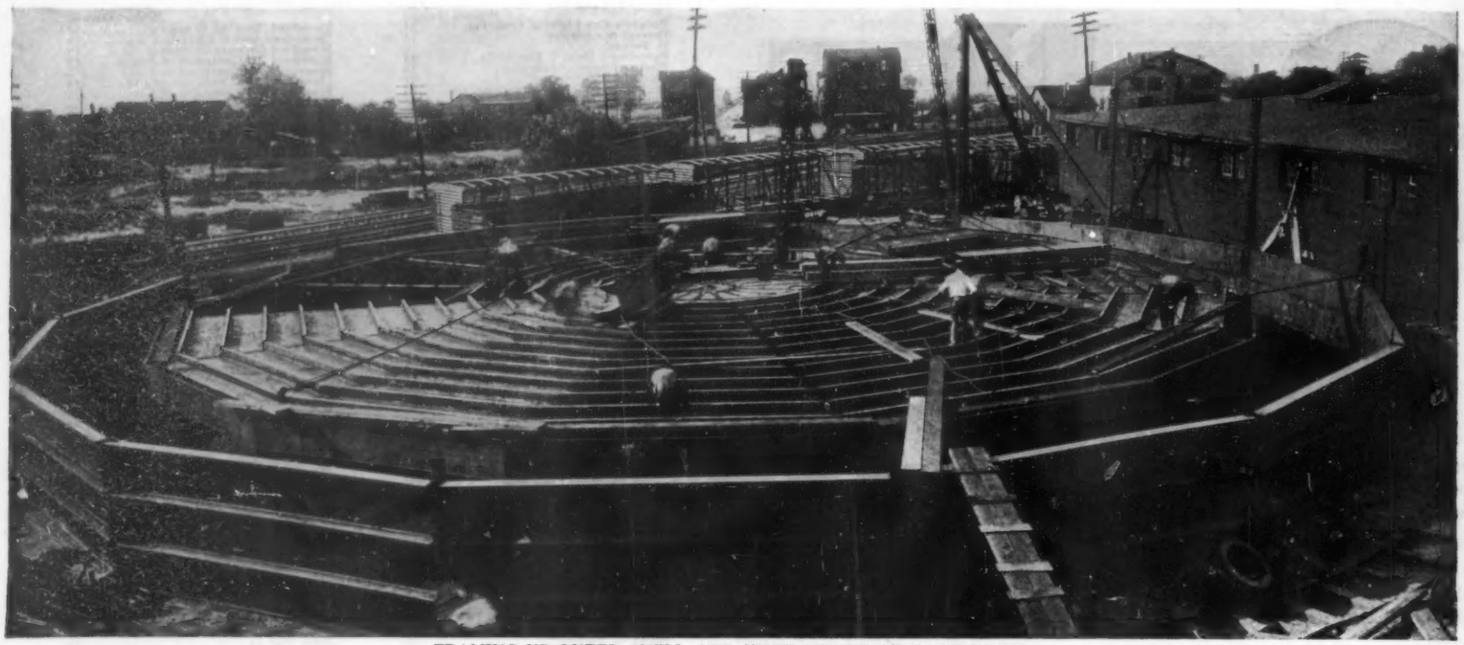


FRAMING UP OUTER SHELL AND HUGE PISTON OF GAS HOLDER

In the standard type, the outer telescopic shell rises and falls as the holder fills and empties. In this new type the shell is rigid and the piston has vertical movement

Something New in Gas Holders

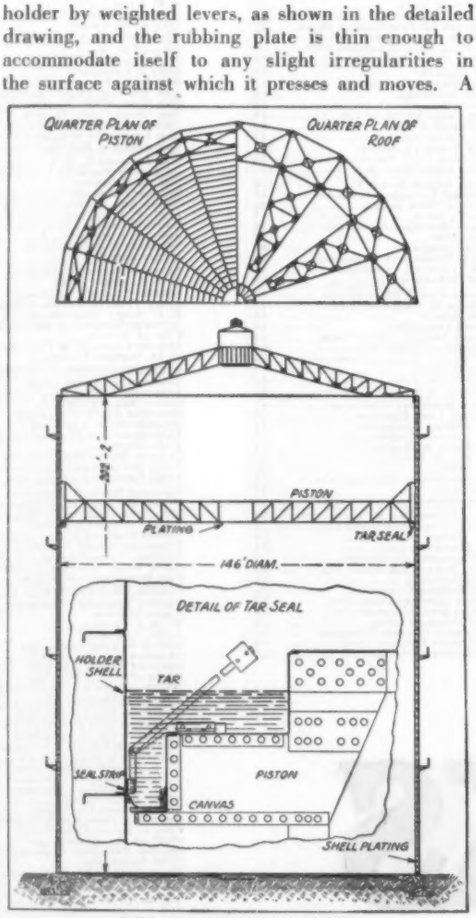
Details of a Waterless, Non-telescopic Gas Holder at Michigan City, Indiana

HITHERTO those huge constructions known as gas holders, have been of the telescopic type. They consist of several cylindrical sections of diminishing sizes, which move down, one within the other, as the gas holder is emptied or which lift, section above section, to the full height as the holder fills with gas. The escape of gas at the bottom of each section is prevented by a water seal.

Non-telescoping Gas Holder

The gas holder shown here consists of an outer polygonal shell, within which is a huge polygonal piston which rises or falls as the gasometer is filled or emptied. The particular gas holder shown in our illustration was built at Michigan City, Indiana, and was the first of the new type to be built in America, although it was preceded by others which were built in Germany, where the design originated. The outer polygonal shell is built of horizontal steel plates whose upper and lower edges are bent over through 90 degrees to form flanges by which the plates are riveted together and which, moreover, serve to give stiffness and keep the interior of each side of the holder in a true plane surface. The piston, as shown in our photograph and drawing, is built up of steel trusses which radiate symmetrically from the center; and its whole area is covered with plate-steel, carefully riveted to render the whole piston gas-tight. To guide the piston in its vertical travel, it carries a series of pairs of wheels which are arranged one above and one below the piston and are mounted in a series of brackets, one at each angle of the polygon.

Outside of the general novelty of this gas holder, the most interesting detail, perhaps, is the way in which the piston is sealed against the escape of gas between itself and the abutting walls. This is done by means of an outer seal, which consists of a flat rubbing plate, turned up slightly on the edges to enable it to glide smoothly as the piston moves. This plate is kept in contact with the side of the holder by weighted levers, as shown in the detailed drawing, and the rubbing plate is thin enough to accommodate itself to any slight irregularities in the surface against which it presses and moves. A gas-tight joint between this rubbing plate and the piston is made by canvas which is attached to the back of the plate and carried over to the side of the piston, as shown in our sketch. The canvas is not subject to friction or any kind of stress, and is durable. A little circumferential tank or trough containing the rubbing plate and canvas is filled with tar, as shown.



DETAILS OF GAS HOLDER

These sectional views show the gas holder shell of uniform diameter; the trussed piston, which conforms to the shell; plans of the piston and roof, and the ingenious tar seal

Such tar as may leak by the rubbing strip runs down into a circumferential reservoir at the bottom of the holder, and the system is so arranged that when the tar level reaches a certain point, a switch will be thrown and the pump will carry the oil back to the tar seal on the circumference of the piston.

The piston is prevented from overrunning and striking the roof of the holder by the provision of several holes through the top of the holder by which the gas can escape. The holder at its top finishes in a series of glass windows through which the piston may be examined.

A Radical Design

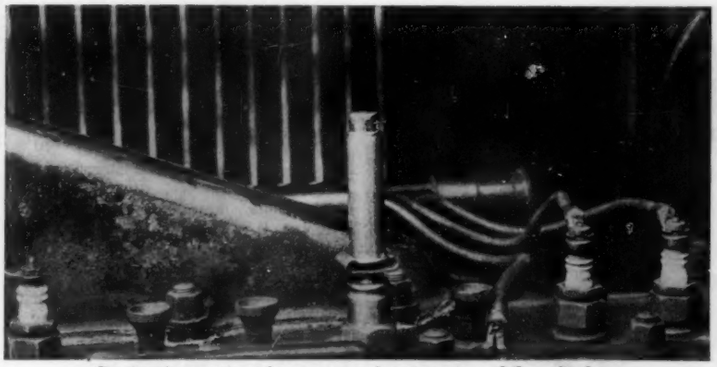
The tank shown in our illustration is of 1,000,000 cubic feet capacity, and a gas holder of this type has recently been built at Flushing, Long Island, which has a capacity of 3,000,000 cubic feet. This tank has a clear height to the under side of the roof of 202 feet, and an internal diameter of 146 feet.

This new design of gas holder is highly meritorious. There is a tendency, today, in engineering to break away from tradition; though it has shown itself more in the smaller than in the class of larger constructions, in which the huge modern gas holders may be classed. Of late years, the spirit of inquiry has put some of our long-established methods of heavy construction under review and with some surprising results; as witness the substitution of the light, single-arched dam for the time-honored, massive gravity dam. The new type of gas holder is an expression of this modern tendency to submit to keen analysis accepted forms of construction.

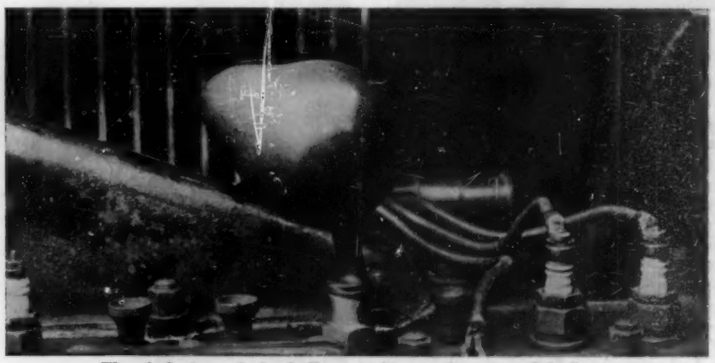
Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins



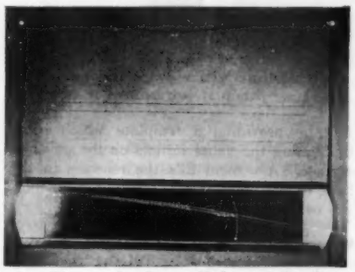
Device for testing the compression in automobile cylinders



The deflation of the balloon indicates the rate of leakage

How Is Your Compression?

A DEVICE for testing the compression in automobile cylinders has been placed upon the market by an Akron, Ohio, company. It is so simple that any car owner can operate it easily and correctly. The tester consists of a plug, similar to a spark plug, which screws into the spark plug hole. A small, specially constructed rubber balloon fits snugly on the end of the plug. After screwing the tester into place, the engine is turned over with the crank until the balloon is inflated. The speed at which the balloon deflates indicates the rate of leakage in the cylinder. There is a metal clip which can be screwed on the tester, which holds an ordinary tire gage. By using the gage, it is possible to compare compression in each cylinder exactly, as the gage will indicate the pressure in each cylinder.



A self-contained parallel straightedge

For Drawing Parallel Lines

THIS parallel straightedge is a simple and convenient means of drawing parallel lines. The instrument is rapidly and efficiently secured to the drawing board by means of four special tacks and one thumbtack. Except for these five tacks, the straightedge is self-contained, the necessary pulleys being entirely housed between the end plates. The cord passes through the straightedge.

An "efficiency" desk for children

The Automatic Volumetric Measurement of Coal

THE operation of the instrument for measuring coal depends on the automatic recording of the product of the cross sectional area and the velocity of the layer of coal passing into the furnace. The meter registers the volume of the coal burnt. The method by which this measurement is affected is as follows: The meter is attached to the driving mechanism of the grate in such a way that the speed of a ratchet wheel is varied in proportion to the grate travel. At the maximum gate height, the counter makes a complete revolution with the ratchet wheel, turning off ten units. As the gate is lowered, the motion is communicated to a cam which throws the two pawls out of contact with the ratchet wheel during a portion of a revolution, so that the number of units turned off by the counter is decreased in proportion to the amount by which the gate is lowered.

A coal meter keeps tabs on the fuel bill

Kitchen Tool of Many Uses

A SMALL kitchen tool having many uses is shown herewith. It sharpens dull knives, lifts the milk bottle cap, removes friction covers from jars and cans, acts as a bottle opener and as a screw driver.

School Desk Made Movable

MODERN school desks are movable and designed to induce correct posture in children. The desk we illustrate may be changed to a side chair without dismounting.

"Kitchenaid" is very useful

It has an inkwell that will not splash or let the ink evaporate. It is provided with drawers for books on both sides.

The top swings out of the way

A new device for the typewriter space-bar

Color Combination for Typewriter Space-bar Relieves Eye Strain

TO aid typists in avoiding eye strain, a new device to be clipped on the space bar of the typewriter has been invented. The attachment is of light-gage spring steel, 4½ inches long, of square section, one side of which is open so as to slip over the existing space-bar. The top is enameled in nine different colors, including white, orange, yellow, cream, red, carmine, pink, brown and black.

A Telephone "Deaf Set"

ONE of the latest products resulting from the research effort of the Bell Telephone Laboratories is a device—available as yet only to a limited extent—that is designed to make telephone service more effective to those whose hearing is impaired. The larger box shown in the picture contains a vacuum-tube amplifier, and the smaller box has switches for adjusting the volume of the amplified speech and for switching the amplifier in or out of the circuit.

An All-in-One Sewing Kit

A RATHER clever contrivance for carrying thimble, needle and thread in a hand-

Either end of the automobile elevating device may be used

bag or traveling case, is shown in the engraving. The thimble is threaded so that it screws on the end of the metal case thus providing a tight top for it.

Pencil Clip Used as a Knife

OUR photograph shows a clip that will keep a pencil in your pocket or that may be used as a knife blade. This combination tool slips on the pencil and is ever ready for use. It has other uses, too, such as raising thumb tacks for draftsmen, opening plate boxes for photographers, or skinning insulation from wire.

The pencil clip is a knife as well

A telephone for the deaf can be readily installed

A wood and steel work bench for the home or shop

A searchlight on the railway train illuminates the scenery

A handy contrivance for the traveler

Automobile Elevating Device

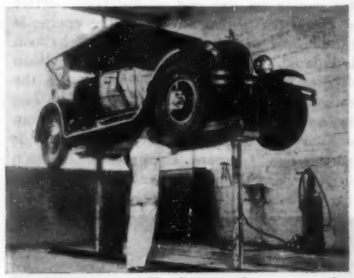
A SAN FRANCISCO inventor has perfected an automobile elevating device which has a cradle with compensating rollers at each end. Thus, either end of the device may be raised independently of the other without binding either of the elevating pistons.

An Efficient Work Bench for Men or Boys

EVERY boy or man finds a use in these days for a work bench. This new wood and steel bench is of particular interest in that it may be purchased "knocked-down" and can be easily put up anywhere.

Everybody Can Have an Initialed Car

A FIRM of Chicago jewelers is selling pierced initials for automobiles. The manufacturer has solved the problem of attaching the monogram to the car in a simple



Both pistons will elevate the car and keep it horizontal

way by providing a template which helps in locating the metal initials on the polished surface. A cement fills the recesses in the back of the plate, thus furnishing an anchorage to hold it to the car.

Observation Car Spotlight Shows Scenery at Night

OUR engraving shows passengers of the "Olympian Limited," of the Chicago, Milwaukee and St. Paul Railroad, enjoying a new flood light. This light enables night travelers on the road's transcontinental trains to enjoy scenery along the route. It is mounted so that it will shift like an automobile spotlight. The light will carry a quarter of a mile and will illuminate a 400-foot area.

Your initials on your auto

Super-Power Line Builders Choose International Trucks

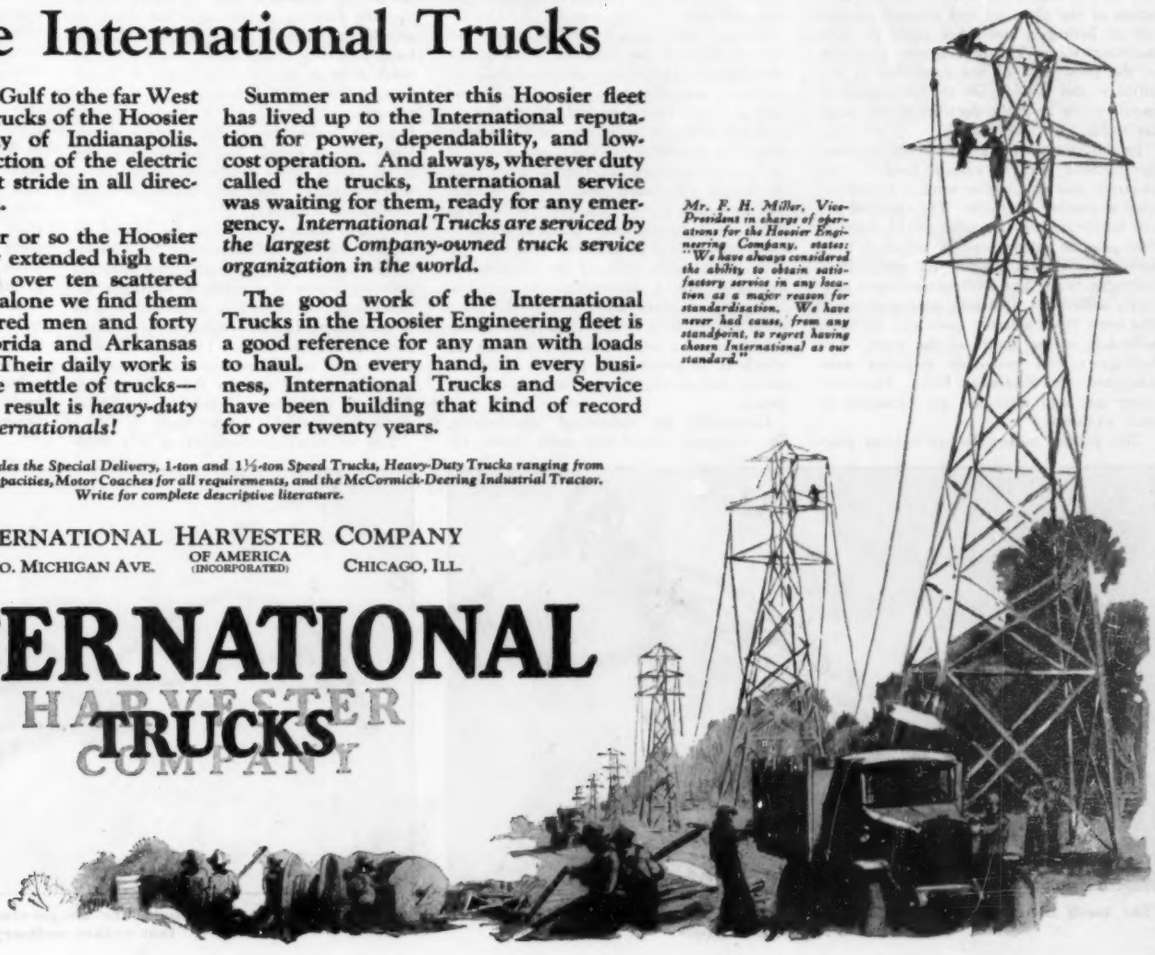
FROM Maine to the Gulf to the far West go the crews and trucks of the Hoosier Engineering Company of Indianapolis. Their work is the erection of the electric transmission lines that stride in all directions across the nation.

During the past year or so the Hoosier Engineering Company extended high tension towers and lines over ten scattered states. In Wisconsin alone we find them marshalling six hundred men and forty motor trucks. In Florida and Arkansas half as many more. Their daily work is the kind that tries the mettle of trucks—and after six years the result is *heavy-duty standardization on Internationals!*

Summer and winter this Hoosier fleet has lived up to the International reputation for power, dependability, and low-cost operation. And always, wherever duty called the trucks, International service was waiting for them, ready for any emergency. *International Trucks are serviced by the largest Company-owned truck service organization in the world.*

The good work of the International Trucks in the Hoosier Engineering fleet is a good reference for any man with loads to haul. On every hand, in every business, International Trucks and Service have been building that kind of record for over twenty years.

Mr. F. H. Miller, Vice-President in charge of operations for the Hoosier Engineering Company, states: "We have always considered the ability to obtain satisfactory service in any location as a major reason for standardization. We have never had cause, from any standpoint, to regret having chosen International as our standard."



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The Scientific American Digest

Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Two New Methods of Producing Ductile Welds

Two methods for producing ductile welds have been developed by research scientists of the General Electric Company, working in different laboratories hundreds of miles apart. Both of the methods, similar in some respects, mark a decided step in the utilization of the heat of electric arcs in the joining of metal parts or the building of metal structures. The one was developed in the Schenectady, New York, research laboratory by Dr. Irving Langmuir; the other was developed in the Thomson research laboratory at Lynn, Massachusetts, by Peter Alexander.

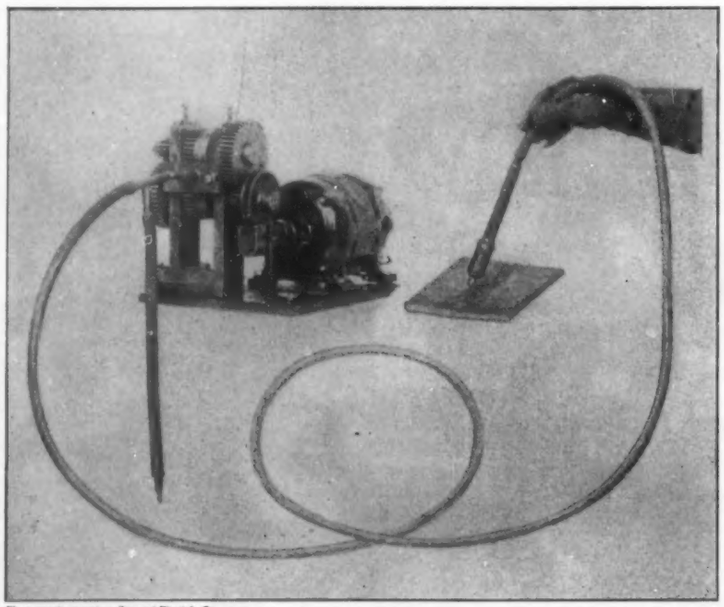
In both processes, air is excluded from the metal by means of a bath of hydrogen or other gas. The formation of oxides and nitrides in the weld metal is thus prevented, and the fused metal is as strong and ductile as the original metal.

In brief, the method developed by Dr. Langmuir in Schenectady is to pass a stream of hydrogen between two electrodes. The heat of the arc breaks up the hydrogen molecules into atoms. These combine again a short distance in front of the arc into molecules of the gas, and in so doing liberate an enormous amount of heat, so that much higher temperatures can be obtained with this than with the usual welding methods. Since atomic hydrogen is a powerful reducing agent, it reduces any oxides which might otherwise form on the surface of the metal. Alloys containing chromium, aluminum, silicon or manganese can thus be welded *without fluxes* and without surface oxidation.

The process developed in the Lynn laboratory by Mr. Alexander is based on the utilization of the chemical and physical properties of hydrogen and other gases in their molecular state. This process aims primarily at the prevention of the formation of the nitrides and oxides in the arc-deposited metal, which limit the ductility of the usual arc welds.

In this process the arc is struck between the metallic wire or carbon used as one electrode and the plate or work to be welded used as another electrode. The crater of the arc is always on the work to be welded. The gaseous atmosphere is supplied in a form of a stream around the arc. Pure hydrogen, water gas, hydrogen-nitrogen mixtures, anhydrous ammonia, methanol vapor and some other suitable gases can be used, according to the nature of the work. The hydrogen-carbon monoxide mixtures were suggested by Professor Elihu Thomson; water gas and methanol are examples of such mixtures.

This process makes the arc welding process more efficient and suitable for the fields which at present are out of its reach. Low carbon steel, alloy steels, and most of the non-ferrous metals and alloys can be welded with success by this process in suitable gaseous mixtures.



Photographs courtesy General Electric Co.

The automatic wire feeding device used with the new Lynn method of electric welding. The motor slowly advances the wire

Fifteen years ago, while studying the loss of heat of the tungsten filaments of incandescent lamps in an atmosphere of hydrogen gas, Dr. Irving Langmuir found that at a high temperature the hydrogen gas changed from the molecular to the atomic state. In the molecular state, two atoms of the gas are grouped together as a unit; in the atomic state each atom acts as a unit. The molecular form is the more stable, and when the atoms recombine to form the molecules intense heat is liberated.

Dr. Langmuir's study of the filaments in hydrogen was a theoretical investigation. Now, fifteen years later, the results have been applied in a different field—in the development of a new method of welding, by which it is possible to produce welds as strong and as ductile as the original materials.

Continuing the theoretical investigation, Dr. Langmuir found that more atomic hydrogen was formed by passing powerful electric arcs between tungsten electrodes at atmospheric pressure. By directing a jet of hydrogen from a small tube into the arc, the atomic hydrogen could be blown out of the arc, forming an intensely hot flame of atomic hydrogen burning to the molecular form and liberating about half again as much heat as does the oxy-hydrogen flame. In this flame molybdenum, one of the most refractory of metals, melts with ease; quartz, however, melts less easily, in spite of its lower melting point. This indicates that the metal assists in the action as a catalyzer—which scientists define as a substance which accelerates a chemical change.

By this method, iron can be welded or melted without contamination by carbon, oxygen or nitrogen. Because of the powerful reducing action of the atomic hydrogen, alloys containing chromium, aluminum, silicon or manganese can be welded without fluxes and without oxidation. The rapidity with which such metals as iron can be melted seems to exceed that in the oxy-acetylene flame, so that the process promises to be particularly valuable for welding.

The technical development of this welding process has been the work of several men in the Schenectady laboratory, including R. A. Weinman and Robert Palmer. These men have developed and tried many types of welding torches, and have tried them under varying conditions. At the same time tests of numerous types of welds have been conducted.

The two electrodes of the torch are tungsten rods, held at an acute angle with each other by lava insulators. When not in use, the electrodes are in contact with each other; they can be separated by pressure on a lever mounted on the handle. A set screw is provided for making slow adjustments of the electrodes. The hydrogen is supplied by a tube through the handle. Sufficient gas is used so that not only are the electrode tips surrounded by enough to form the blast of atomic hydrogen but by an additional quantity to surround the work with hydrogen.

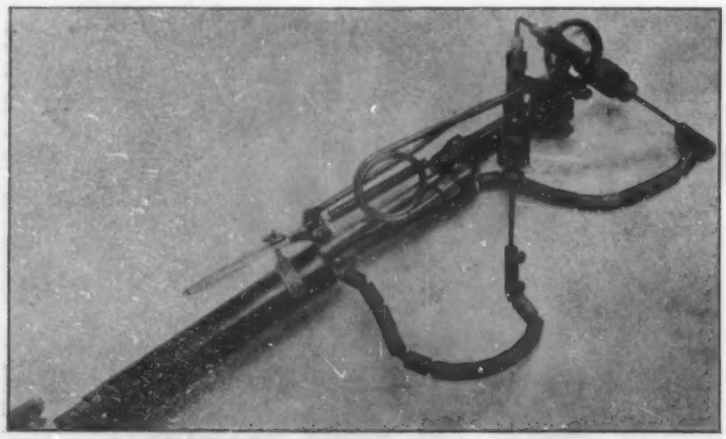
Either alternating or direct current can be used. The first mentioned has been found more convenient, and electrodes of smaller diameter can be used. The gas pressure required to operate the torch is very small; in the laboratory, with short lengths of tubing, a pressure of less than one pound per square inch was sufficient with metals up to one-half inch in thickness. For ordinary welding, the rate of gas consumption varies between 20 and 30 cubic feet per hour.

Experiments have been conducted with several gas mixtures and various electrode materials. The best results have usually been obtained with tungsten electrodes and hydrogen alone.

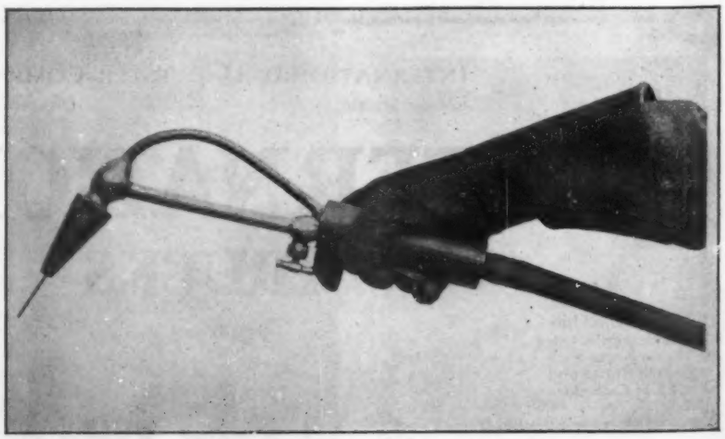
Materials of many kinds have been successfully welded by this method. Low carbon steelz up to one-half inch in thickness have been welded without additional material, after butting together tightly. Considerable work has also been done in connection with full automatic welding using a butt joint, and with no metal being added to the seam. A number of welds have been made on seamless tubing having a wall thickness of one-quarter inch and an outside diameter of four inches, and with boiler plate iron one inch thick. Welds on deoxidized copper such as silicon-copper have been made up to three-eighths inch thick metal, giving unusually good sections.

In testing welds made by this process, the welded portions have been twisted and bent double without cracking or otherwise being injured. Such a procedure has not been possible with the ordinary arc weld, since such welds are usually brittle because of the presence of nitrides or a thin film of oxide

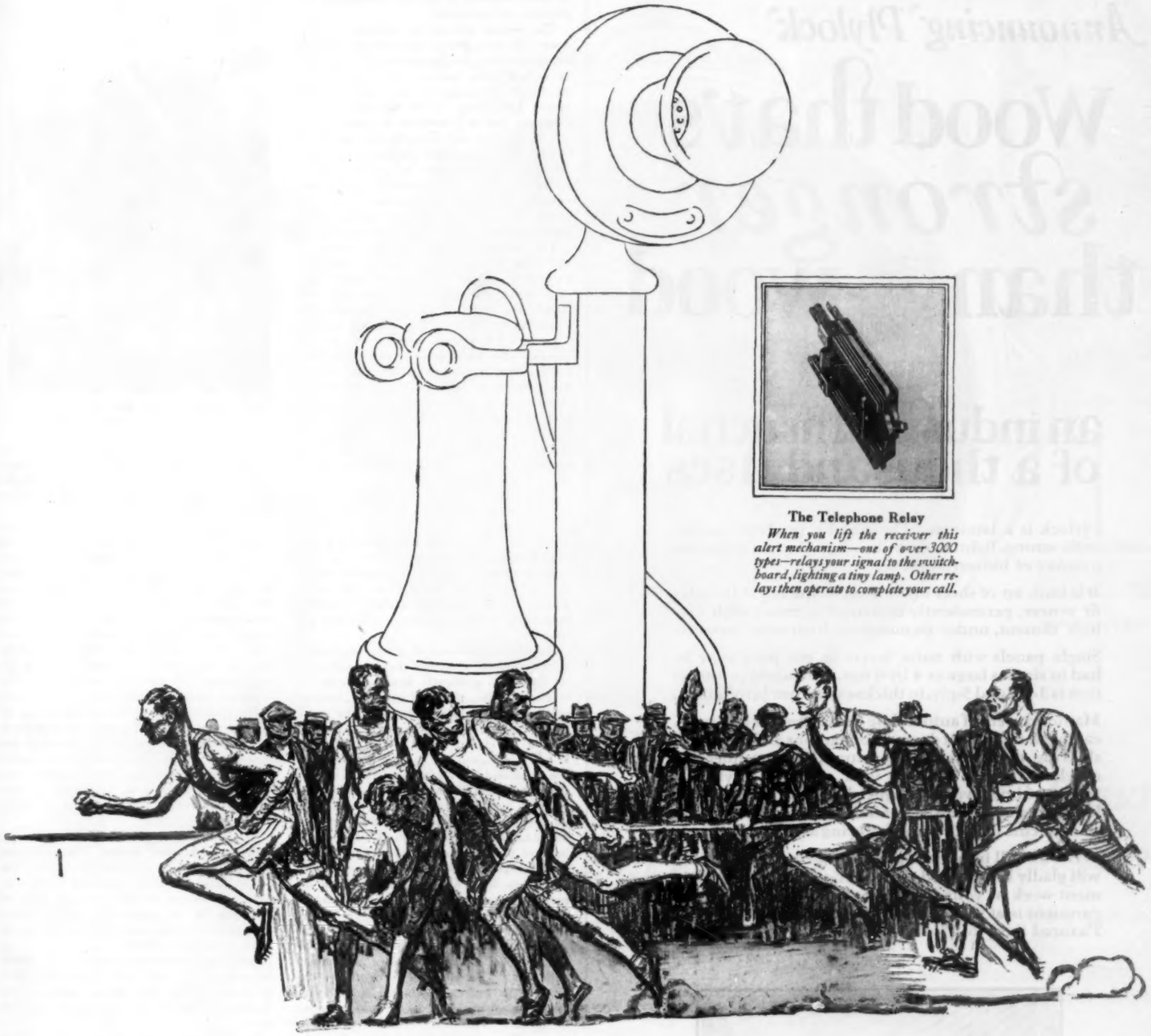
(*Continued on page 404*)



The torch used in the Schenectady method of making ductile welds. The two electrodes are tungsten rods



A stream of hydrogen excludes the air, preventing the formation of compounds that weaken ordinary welds



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or scale, removed in the new process by the presence of hydrogen.

The second method is explained as follows: By surrounding the ordinary welding electrodes with an atmosphere of hydrogen or certain other gases, it has been found by Peter Alexander of the Thomson Research Laboratory of the General Electric Company that it is possible to produce ductile welds. The gas acts as a flux and shield against the oxygen and nitrogen of the air; therefore the formation of oxides and nitrides of iron in the molten metal is prevented. The process originated from the study of metallurgy of the arc-deposited metal and the causes that limit its ductility.

The method is based on the action of molecular hydrogen. This gas at high temperatures, even in the molecular state, is a very active reducing agent. When it surrounds the crater of the arc it acts in the same way as it does in the hydrogen brazing process. Yet certain peculiarities of the process (for example, the extremely high voltage drop at cathode and anode of the arc burning in hydrogen) are due to the dissociation of the small amounts of molecular hydrogen in actual contact with the craters. Hence the apparent resistance of the arc, and consequently the amount of energy liberated, is about double that when the arc is burning in air.

Consequently the weld is not only ductile, but the operation is much faster. The speed results both from the greater energy of the arc in the hydrogen atmosphere and the fact that beveling of the edges of the material is unnecessary. Using 180 amperes and an arc voltage of 60, one-quarter inch boiler plates, butted together without beveling, have been welded at a speed of 60 feet per hour.

Ductility is a factor of prime importance in the welds of structures that are subjected to vibration, accidental bending stress, or overload. Also, ductility equalizes internal cooling stresses when present in the weld. If any part of the ductile weld is stressed beyond its elastic limit, it will not crack. It will yield until the stresses are more or less equalized all along the joint, which is so proportioned as to stand with safety the imposed load. It has also been found that the metal deposited in the hydrogen atmosphere has a higher elastic limit. The elastic limit of pure iron electrodes before deposition averages 29,000 pounds per square inch; the elastic limit of the same electrode deposited by the arc in hydrogen averages 42,000 pounds per square inch.

In this welding process the arc is maintained inside of a hydrogen stream which burns along its outer surface of contact with air. The electrode is entirely surrounded by hydrogen, which eliminates the possibility of the metal in the crater coming in contact with air. Direct current is used. The equipment as developed in the laboratory includes the direct-current generator, gas hose, and spool of welding wire mounted as a unit on one base. The welding wire, the hydrogen gas and the electric current are sent through a flexible hose to the torch nozzle.

Mr. Livengood's reflecting telescope. The axes are Ford axles

After the work with the hydrogen atmosphere was found to be successful, experiments with mixtures of hydrogen and carbon monoxide were conducted in accordance with Professor Elihu Thomson's suggestion, and under his personal guidance. Water gas, containing about equal volumes of hydrogen and carbon monoxide, was next tried. It was found that welds produced in such an atmosphere were ductile and easier to produce. Work with various mixtures of carbon monoxide and hydrogen, produced either synthetically or by decomposition of various organic compounds, demonstrated that ductile welds can be produced in the atmosphere of any mixture of the two gases. Methanol or synthetic wood alcohol was found to serve well in this gas, so that transportation with portable outfits is facilitated.

A series of experiments with nitrogen-hydrogen mixtures showed that mixtures of these gases also give ductile welds. The use of liquid anhydrous ammonia which contains one volume of nitrogen and three of hydrogen, in this connection makes it possible to store large quantities of the gas in small volume as a liquid.

Still other gases and methods are being investigated in the Lynn laboratory, and academic studies are being made of the theoretical aspect of welding in different gases.

In its present state the process is being

(*Continued on page 406*)

Mr. Wade's telescope, described on the next page, is driven by a phonograph motor, through a worm-wheel

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Cabinets for testing timepieces. Their temperature is kept uniform by means of thermostats

extended to the welding of alloy steels, nonferrous materials and their alloys. The careful selection of the appropriate gaseous mixture determined by the nature of the materials to be welded is an essential factor.

In brief, this process is a combination of an electric arc which supplies the energy and an appropriate chemical reagent which, being in a gaseous state and at extremely high temperature, acts almost at once.

* * *

Two Ford-Parts Telescopes

Two well-made reflecting telescopes, having in common the use of the rear axles of Ford cars for the polar and declination axes, and constructed by Mr. Lester M. Livengood, of Spokane, Washington, and Mr. A. Wade, of Los Angeles, California, are shown on page 404. The original Ford axle mounting was described by Mr. Clarendon Ions, of Miami, Florida, in *Popular Astronomy*, February, 1925 (description reprinted in "Amateur Telescope Making," 1926, Scientific American Publishing Company, New York). In both telescopes the parts of the Ford rear axle assemblies, which may be picked up at very low cost at public garages, show clearly.

Courtesy of the U. S. Bureau of Standards

Fiefler clock, the standard for timepiece tests. Accurate to .02 second per day

Mr. Wade states that the tube of his telescope is a section of ten-inch irrigation pipe. His mirror is ten inches in diameter. The driving clock is an old phonograph motor, with gearing interposed. He states that the barrel which shows in the background of the picture is the stand on which his mirror was made. With the exception of some welding, all work was done at home.

Mr. Livengood did not include a description of his telescope, which however, quite closely resembles the original Ions mounting. In this, the base was made of concrete.

Neither of these instruments was originally inspired by the recent effort of the Scientific American to arouse interest in amateur telescope making, having been finished previous to that effort. Noting our effort, the respective makers sent us photographs of their creations.

Before long, photographs should begin to reach us from the first thousand amateur enthusiasts who began work on their telescopes shortly after the publication of the book, "Amateur Telescope Making," in March. Preferably, such photographs should include the makers, since they are more interesting thus.

* * *

Testing Timepieces at the Bureau of Standards

CERTAIN definite tests have been arranged by the United States Bureau of Standards for three distinct classes of timepieces, namely: pocket watches, stop-watches, and chronometers, according to R. E. Gould. Special tests are also prepared for other forms of timepieces, such as clocks, where no specified test has been provided.

The standard for all such tests carried out at the Bureau is the Riefler clock. This is kept in a constant temperature room in the basement of the building. This clock varies only about 0.02 second a day, and it is compared each day at noon with the Naval Observatory signal, as relayed by radio from Arlington.

The seconds ticked off by this standard clock are transmitted to the testing laboratory through a relay, where they are recorded on a drum chronograph, by a pen. This same pen may also be made to record on the same sheet other signals given by a telegraph key which is inserted in the circuit, and operated by the observer.

As a reading on a watch is made the observer closes the key and thus makes a permanent record on the chronograph sheet, of the exact time of the operation. The difference between the true time and the observed time gives the correction to the watch reading and this correction, compared to that of the previous day, gives the rate or daily change in the watch reading. This method of recording results is used for all timepieces.

The tests of pocket watches cover both positions and temperatures, and are divided

(*Continued on page 408*)

Prof. Duff Abrams (left), under whose direction the calorimeter sand test was perfected

into three classes, namely: "Class A," "Class B" and "Railroad Precision."

"Class A" is a very accurate test consuming 53 days and putting the watch through five positions, three temperatures, and a test for isochronism, that is, the hourly change in rate as the watch runs down. Three days are given to each position and five days to each temperature, with an intermediate day for change of temperature.

The "Class B" test is a less severe test than "Class A," two of the positions and the test for isochronism being omitted. The test covers 40 days and is applied largely to watches which have failed to meet the requirements of the longer test.

The "Railroad Precision" test requires only 19 days, but is equal in most respects to the other two tests. It devotes only two days to each of the five positions and three temperatures, and furnishes a much quicker means of judging the performance of the watch.

The stop-watch test consists of determining the corrections for various intervals ranging from 30 seconds to five minutes, the results being recorded on the record sheet by the closing of an electric circuit. In the case of pocket chronographs the daily rates in the vertical "pendant up" position and the horizontal-dial-up position are also determined.

Chronometers are tested for three temperatures and for isochronism, the test being divided into eight periods of three days each with intermediate days to allow for temperature change. Isochronism (uniform in time) is taken for 36 hours to determine the regularity of performance through the day when the chronometer is kept at a constant temperature.

This test usually takes about one month.

More complete information than the above may be obtained from the Bureau of Standards (Washington, D. C.) Circular 51.

* * *

A Simple Color Test for Concrete Sand

THAT sand must be clean before it will make strong concrete is a common saying. But investigators of the Structural Materials Research Laboratory, maintained by the Portland Cement Association in cooperation with Lewis Institute, Chicago, have discovered through experiments covering a period of years that "clean" is a rather broad term. So says G. E. Warren, Assistant General Manager of the Portland Cement Association.

"Dirt" in sand has long been the bane of contractors, whose success depended on turning out work that measures up to the possibilities of the material. However, the average cement user would be hard put to define "dirt." Tests show that some sands which apparently contain considerable dirt will make fair concrete, yet some sands which appear clean to the eye will produce inferior concrete.

Appearance is not at all conclusive in deciding on the worth of sand to mix with cement.

Experimenters at the Structural Materials Research Laboratory have determined through thousands of tests that the only forms of "dirt" which are detrimental to concrete are organic in nature, usually humus, although an excess of any foreign material will be harmful, whether "dirt" or not. In addition to these, there are certain wastes from industrial processes which will

Test solutions for concrete sand. *Left:* Suitable for most exacting concrete. *Center:* Safe where exceptional strength is not required. *Right:* Unsafe unless sand is thoroughly washed

prevent the formation of a strong concrete.

Humus and the industrial wastes prevent concrete from hardening properly. The cementing action is delayed, and when it does occur the resulting mass is weak.

The harm from humus arises from the acids formed by all decaying vegetable matter. These react chemically with the cement and prevent it from hardening normally. Such acids vary, of course, with the nature of the vegetation from which the humus is derived. While the formulas of these acids may differ, their general properties are such as to group them into a broad class. And of this class, tannic acid—produced by the decomposition of oak leaves and bark—has been chosen by research workers as the yardstick because its reactions are typical of so many others.

Tannic acid in water reacts with sodium hydroxide to produce a dark colored solution. The other acids found in humus are not identical with tannic acid. But empirical experience has shown that with very few exceptions they, too, produce the same brown color when treated with a sodium hydroxide solution. It should be noted,

Crushing a cement mortar cylinder at the Structural Materials Research Laboratory. The accuracy of the sodium hydroxide determination of the suitability of sands has been verified thousands of times by these crushing tests

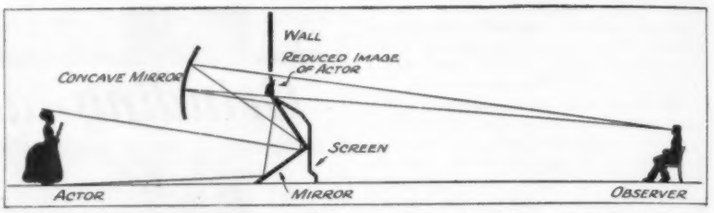
however, that lignite, which is not a serious detriment, produces a dark brown reaction which frequently deceives the inexperienced.

Once the foregoing facts became established, it was easy to devise a colorimetric test for concrete aggregates. The stronger the acid, the darker the color. Hence, to determine the suitability of any fine aggregate for cement, it is necessary only to mix a small portion with a sodium hydroxide solution and observe the shade resulting.

The standard field test is made as follows: Fill a 12-ounce prescription bottle to the 4½-ounce mark with the sand under examination. Add sufficient 3-percent sodium hydroxide solution to bring the total volume to the 7-ounce mark. Shake thoroughly and allow to stand 24 hours. The color of the solution then determines whether the sand will make sound concrete.

If the color is light yellow—like very weak tea—the sand is reasonably free from organic impurities. If the color is slightly darker, the sand may still be used, but not for high-grade work like roads, pavements or reinforced building construction. If the color is definitely brown, it should not be used as it stands in any concrete. Often the humus may be washed from such sand. But no matter how thoroughly it is washed, it should not be employed until the test shows a light colored solution.

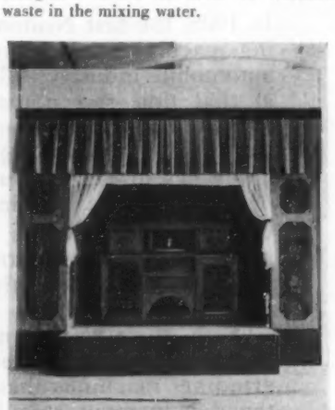
Sometimes the rejection of a quantity of



Optics of the Tanagra Theatre. The lower plane mirror inverts the image, the upper one re-erects it. The concave mirror then reduces it to miniature size

sand would mean a considerable financial loss. Then it may be worth while to ascertain whether the dark reaction given is not due to the presence of lignite. This, as has been said, is not a serious detriment except for the most particular types of work. Lignite is a form of coal, and will appear as small black grains mixed with the lighter particles. If such grains are observed, the final determination of their nature should be left to a laboratory. It is almost impossible for the layman to distinguish them from several forms of humus.

If the colorimetric test gives a light reaction, and yet the mix refuses to harden or is unusually slow in gaining strength, investigation should be made for industrial waste in the mixing water.



How the actors appear to the viewers, in miniature. The term "Tenagra" is from the ancient Greek town where miniature figurines were made in pre-Christian times

Silt in small quantities does not always lower the quality of concrete, but where a great deal of it is present the strength may be seriously affected. If the aggregate be coated with silt, the cement will fail to get a good grip on it. If the silt be merely mixed in the mass without coating the aggregate, its presence in large quantity will require so much additional water to make the mix workable that the resulting concrete will be weakened.

If the silt is of an organic nature the test described above will reveal it by the color. But if the silt is inorganic and no dark color appears, it can still be detected by the muddiness of the water in the test bottle when it is first shaken. When everything has settled the silt can be seen as a fine powder lying on the sand.

Tests show that humus equal by volume to only 25/1000 of 1 percent of the total mix may rob it of from 10 to 15 percent of its strength. Any humus which would give a really dark brown reaction to the sodium hydroxide would represent probably 1/10 of 1 percent of the volume of the sand. If the sand contains as much as 1 percent humus by volume, the strength of the cement would be cut anywhere from 50 to 75 percent. Possibly the mass would not harden into concrete at all.

Corresponding figures have not been worked out with regard to silt. But it is known that one pint too much of water in a one-bag batch will weaken the mass as much as though two or three pounds of cement were left out.

The safest method of insuring strong concrete is to select aggregate so free from contamination that the colorimetric test will serve merely as a check on the quality. However, if the check fails to reveal a low organic content, the aggregate should be rejected or washed thoroughly. Concrete made with it would lack the desired strength and durability. In case the organic content was very high, the concrete might even fail.

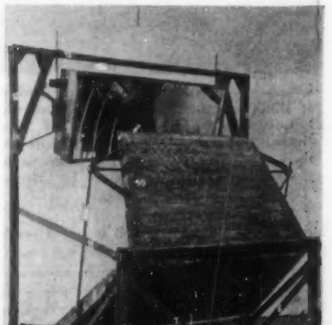
* * *

The Lure of the Tanagra Theatre

WHICH one of us has grown too blasé not to remember those joyous days of our earliest youth when we watched, wide-eyed and open-mouthed, those funny Punch and Judy shows and those delightful Marionette theatres, with their weird, grotesque characters, whose antics caused our sides to ache with laughter? Now we have a more scientific form of amusement in the Tanagra theatre. Tanagra figures were made of terra cotta in Tanagra, a town of ancient Greece. The little statuettes date back to the fourth and fifth century B. C. To these figurines the Tanagra theatre owes its name.

Visualize, for a moment, a miniature stage, the greater part of which is taken up by a console, fashioned along classical lines. Placed upon it, in a Grecian vase, is a beautiful Maréchal Neil rose, against a subdued background. The small audience, perhaps two or three dozen persons, is watching the attractive setting with eager anticipation, when suddenly—as if by magic—an elfin-like maiden seems to rise from the petals of the rosebud.

The combination of the soft, dreamy strains of Offenbach's "Barcarole" and the scented atmosphere add greatly to the illusion of the Tanagra figures. One is in fairyland.



The mirror arrangement, showing the backs of the two plane mirrors and the front of concave mirror

With a captivating grace and charm impossible to describe, the little Tanagra dancer pirouettes along the subdued background, her dainty form hardly larger than a tiny Dresden doll—now seemingly floating through the air, and then, as if by magic, disappearing in the rose petals, whence she came.

The entrancing strains from "The Tales of Hoffman" die away, slowly the soft lights become brighter and brighter, yet, there we of the audience sit, spell-bound, scarcely able to realize that the graceful miniature dancer is a real, live adult, dancing behind the stage, whose image through a set of mirrors, has been transformed into a little fairy. Naturally, we want to know how this effect is accomplished.

Upon visiting back-stage we are shown a comparatively simple arrangement consisting mainly of two mirrors at right angles, placed near the ground. Into them the image of the dancer is thrown against a darkened background. This image is then reduced in size by a parabolic mirror in the rear, which reflects the greatly reduced image against the background of the rose and vase.

The illusion is perfect; and upon seeing this comparatively simple equipment, we wonder why more of these charming little Tanagra theatres are not being used in America.

Naturally, the arrangement need not be confined to vases and dancers. Very striking effects may also be obtained, by displaying a fish bowl or an aquarium on the console, within plain view of the audience, in which the effect of a swimmer disporting herself among strange fish and deep-sea creatures is presented. This swimming illusion may be accentuated by the crawling and stroking motion of the actual performer, who is suspended back-stage by a thin wire invisible to the audience. The illusion of angels descending from heaven may thus be accomplished, and the effect of other forms of expensive trick-staging and film photography may be produced at a fraction of the cost of methods heretofore employed.

Shop windows, too small to allow proper display of merchandise by living models, have also effectively used the Tanagra theatre system by employing space back of the window. In this manner it has repeatedly been possible to stage entire miniature acts, displaying special merchandise and demonstrating them before such crowds that traffic was actually halted. To the uninitiated the effect is quite baffling and in a comparatively short time the advertising value derived therefrom more than pays for the cost of the equipment.

* * *

Sound Waves and the Architect

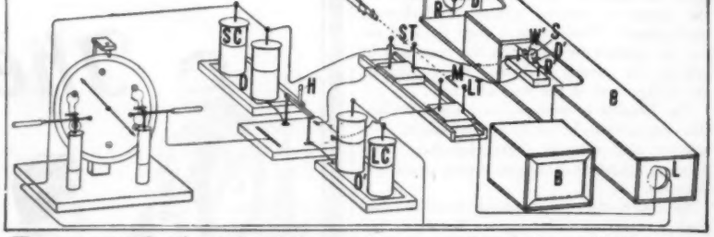
UNTIL quite recently there was no such thing as a science of architectural acoustics. In designing auditoriums, architects worked largely on the hit-or-miss basis. When the auditory properties of a room turned out good, it was a sheer stroke of luck. When they turned out bad, all sorts of partly successful, partly futile efforts were made in an attempt to correct the mistakes.

The chief acoustic factors with which the architect must deal in designing an auditorium are the materials for the walls, the ceiling and the floor; also the shape of the room. An ingenious method of sound-wave photography has been developed at the Riverbank Laboratories, Geneva, Illinois. Thus, it becomes possible to study the acoustical properties of any given architectural design. First of all, plaster of paris models of a horizontal section and a vertical section of the auditorium are prepared, exactly to scale.

The apparatus by means of which this is accomplished is shown in diagram on next page. A plaster of paris model of the tentatively designed auditorium is placed over and around the apparatus for making electric spark. The latter creates a single sound wave and an instant later there comes another flash for the purpose of photographing (literally, it is not photographing, but "shadowgraphing") the shadows of the resultant waves on a photographic plate.

Inasmuch as sound travels at 1,100 feet per second, depending slightly on temperature, and since we are dealing with waves at most only a few inches from their source, it is evident that in these experiments we are dealing with very small time intervals; these lie, in the average case, between 1/1000 and 1/20,000 of a second.

The control of the sound-producing spark and the light-producing spark is accomplished by means of trigger gaps which are struck in rapid succession by a bullet fired from a high-power rifle. The trigger gaps can be spaced closer or farther apart, in order to secure the desired time interval. As the rifle bullet passes through each trigger gap, it permits the high-tension electric



The apparatus for the study of the sound waves produced when a high-powered rifle is fired. The details are explained in the text

charge to pass from the condensers to the respective spark gap. The condensers, in turn, are charged by means of a static machine, well known to the physics classroom.

In the diagram, an ordinary photographic plate *P*, is placed at end of shadow box, *B*. Upon this plate an intense electric spark at *L* casts a shadow of anything between it and the plate. If, therefore, an earlier spark at *S* has produced sound waves, the shadows of those waves will fall on the plate. *W'* represents expanding sound wave, and *W* represents its shadow on the plate. Small disks *D'* prevent the sound spark from fogging the plate. *R'* and *R* are the stand and shadow, respectively, of sound spark gap. The two spark gaps are controlled by trigger gaps *ST* and *LT*, respectively, which in turn are operated by a bullet *M* from a high-power rifle which passes through them, thus permitting high-tension electric charges to jump across the trigger gaps and operate the two spark gaps in rapid succession. The high-tension electric charges are supplied by condensers *SC* and *LC*, on stands *O* and *O'*, which are charged by the static machine at the left. The switch *H* prepares the condensers for a charge or discharge. *B* is a sand box to catch the high-power bullet.

By studying the cryptic lines on the photographic plate obtained with this sound-wave photography apparatus, the skilled technician interprets the performance of the architectural design. Thus it becomes possible to test the architect's plans while they are still in the blueprint stage.

* * *

Electrical Treatment Fails to Influence Plant Growth

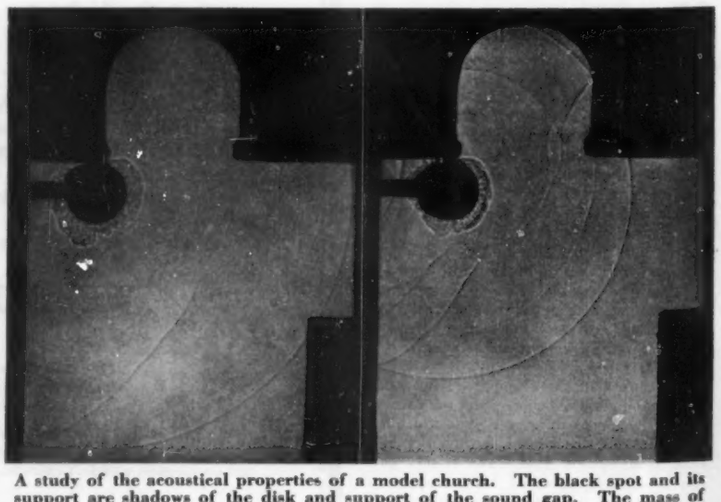
EXPERIMENTS for testing the influence of electricity on plant development have been conducted in various places and under varying conditions of refinement during the past 75 years. Results have varied so much that at the present time there is still a diversity of opinion concerning the influence of electricity on plant growth, says the United States Department of Agriculture.

Some of these experiments in "electroculture" indicate that the yield of crops can be materially increased by electrical treatment. Others, conducted along similar lines, fail to show any marked response to the treatment. The United States Department of Agriculture has failed to discover any marked reaction of plants to electrical treatment in any of the experiments in which it has had a part.

In the department tests the application of electrical force to plant life was made by means of a charged network placed over the growing crops, high enough to permit of their cultivation with horse-drawn implements. In most of these tests the potential of the network was approximately 50,000 volts. The network was charged throughout the night, from late afternoon until early morning, the plants being subjected to electrical treatment about 656 hours in all, extending over the period from June 20 to September 16. Yields of the vegetable crops so treated were so lacking in uniformity that no great dependence could be placed on the results. And furthermore, only in one of the ten trials recorded did the treated plat show any evidence of a substantial increase in yield when compared to the check plats. Experiments of this nature have been conducted by the department over a period of eight years during which time no well-defined increase in yield of the crops tested has been secured.

The department tests were conducted under the same general experimental procedure as that employed in experiments which were conducted in England in which the electrical treatment is reported to have increased yields.

A report of the work done by the Department of Agriculture has just been published and includes also a brief account of other investigations in the field of electroculture. The report is known as Department Bulletin No. 1379, Electroculture. A copy may be secured while the supply lasts by writing to the United States Department of Agriculture, Washington, D. C.



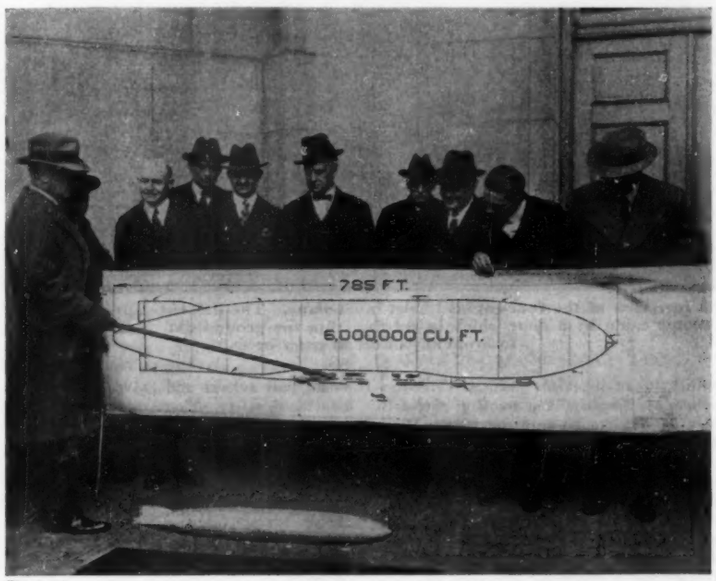
A study of the acoustical properties of a model church. The black spot and its support are shadows of the disk and support of the sound gap. The mass of bubbles on the disk is due to the heat of the spark gap. The spread and reflexion of the sound waves show clearly

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics, New York University



Wide world

Admiral Moffett demonstrating to the House Committee on Naval Affairs plans for a giant airship of 6,000,000 cubic feet capacity, nearly three times that of the *Shenandoah*, and carrying five airplanes for defensive purposes

Superairships

THE disaster of the *Shenandoah* was far from convincing the Navy that the construction of large rigid airships should henceforth be abandoned. Admiral William A. Moffett has convinced the House Committee on Naval Affairs that development of this type of aircraft must continue. A bill now before the House calls for the construction of two giant airships far larger than the *Shenandoah*. They are to have a capacity of 6,000,000 cubic feet, a length of 785 feet and a diameter of 122 feet, as compared with the *Shenandoah's* 2,100,000 cubic feet of gas volume, length of 680 feet and diameter of only 79 feet. They will cost $4,000,000 a piece, or about twice as much as the cost of the *Shenandoah*.

Is there any justification for such construction in increased sizes? Admiral Moffett gave many powerful arguments to the critical House Committee. The volume of an airship goes up as the cube of its linear dimensions; its surface and area projected on the line of the wind only as the square of the linear dimension. Hence the larger the airship the less the power required proportionately to drive it through the air at the same speed. The *Shenandoah* could only make 64 miles an hour. The proposed airship would make 85 miles an hour, and increased speed makes not only for greater military utility but also for increased safety by virtue of ability to outspeed a storm. Also, with the larger airship a stronger hull, and an increased radius of action are possible. The military load carried also increases.

The airship which is shown in our photograph would be able to carry in addition to fuel for a range of 7,000 miles, five or six fighting airplanes, and machine gun platforms at many points. Filled with helium gas so that it is not highly vulnerable to gun fire and provided with these machine guns, and readily releasable airplanes, the proposed airship would be able to fight off even a powerful airplane attack. Moffett summarizes the military advantages as follows:

"With an airship such as can be built, I would not hesitate to venture into any theatre of operations for the purpose of obtaining information of the enemy forces. If an enemy airplane is encountered and flies over the airship firing bullets into it, the holes made in the gas cells will be stopped by the crew before any considerable loss of gas is encountered."

This revival of interest in large airships is strengthened by the fact that the British Government is actively pushing the construction of two airships, likewise of 6,000,000 cubic feet each, to be used on completion in an Imperial service from Cairo to Karachi, India. One of these is to be built of stainless steel and will be equipped with heavy, oil-burning engines to offset the dangers of the inflammable hydrogen which Great Britain is forced to use for lack of a supply of helium. The other British airship is to use gasoline engines and to have a structure of duralumin. The lead of the ultra-conservative English is not to be disregarded.

A Novel Engine Mounting

THE Udet Company of Germany has recently brought out a four-engined passenger plane, with the engines spread out under the wing. A pilot and a navigator occupy a cockpit at the front part of the central fuselage where their vision is scarcely impeded in any direction. The passengers are seated in eight comfortable armchairs in a roomy cabin, to which ingress is but a matter of a high step from the ground through a large door.

The plane has every indication of an excellent design. But it is the engine mounting which is most interesting. The use of four engines is a safeguard against engine failure, since flight should be possible with any two engines out of commission, or at least with an engine on either side out of commission. The placing of engines on the wings of a monoplane offers many difficulties however. The propeller placed in front of a wing may influence its efficiency unfavorably and the engine nacelle itself is hard to streamline.

The Udet Company has met these diffi-

A rear view of the four-engined Udet monoplane. The passenger proceeds to a roomy cabin by a door which is not far from the ground and is large enough to avoid any effort in entry or exit

culties in an ingenious fashion. The propellers are "pushers" not tractors; therefore they do not interact with the wing. There being no propeller in the way, the front of the engine nacelle can be beautifully streamlined. And, as the propellers are driven through a fairly long transmission shaft, the rear of the engine nacelle is also of the best aerodynamical form. While the introduction of a transmission shaft may not please the conventional designer, the decrease in air resistance achieved thereby is of real value.

Ideas

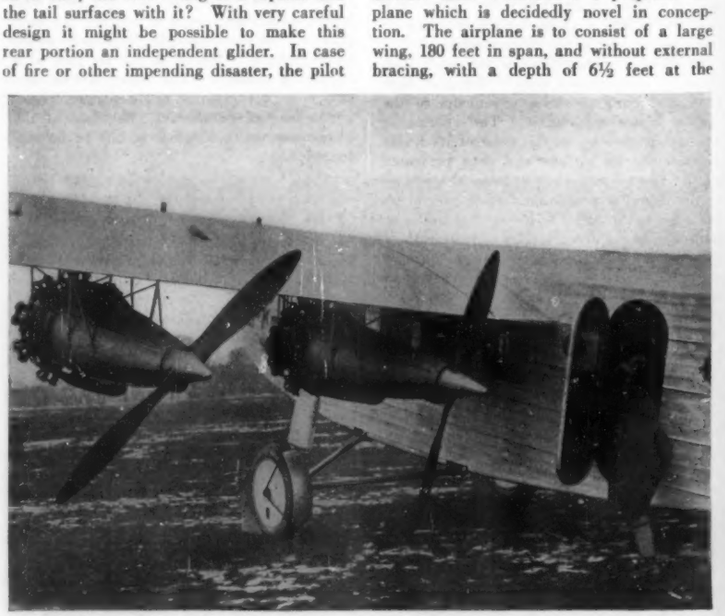
EVEN though the art of aviation is yet young, aeronautical conceptions have a tendency to become stereotyped. It is refreshing to read in *Aviation* an article on "Possible Lines of Aeronautical Development," which embodies radical yet plausible suggestions.

It seems to be the consensus of opinion that passengers will not make use of parachutes. The design of a parachute which should waft the passengers to safety without their own volition is fraught with difficulties. Why not make the rear part of the central fuselage readily detachable and so designed as to carry the lower wing of a biplane and the tail surfaces with it? With very careful design it might be possible to make this rear portion an independent glider. In case of fire or other impending disaster, the pilot would pull a lever and guide his auxiliary airplane to safety. There are in such a plan, structural difficulties, difficulties in balancing the craft as a whole and the glider separately, and at the moment of separation trouble might be experienced in the disturbed air. Still, the idea is worth thinking about. We are told that Edison himself has been thinking along these lines.

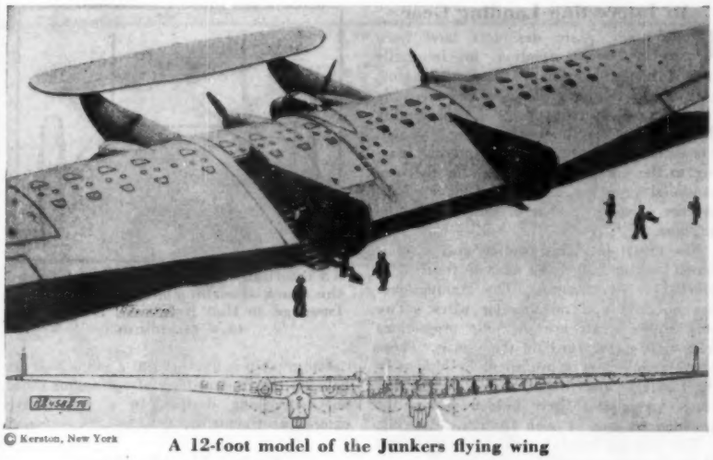
Devices for reducing landing speed are innumerable. Perhaps the most noteworthy is the Handley Page slotted wing, (already described in these columns) with which it is possible to increase the lifting capacity of a wing 100 percent at the moment of landing. Now comes the idea that a very thick monoplane wing might be so arranged that the under part of the wing would at a given moment drop a few feet below the main wing, thus converting the monoplane into a biplane and providing extra lift. If used in conjunction with the Handley Page slot, the increase in lift would be very powerful. Perhaps the mechanical difficulties might not prove insuperable.

A Daring Conception

THE well known German constructor, Junkers, recently exhibited at a Swedish aircraft meet a model of a proposed airplane which is decidedly novel in conception. The airplane is to consist of a large wing, 180 feet in span, and without external bracing, with a depth of 6½ feet at the



A side view of the Udet monoplane. It utilizes four engines as a safeguard against power plant failure. It is always difficult to streamline the ordinary engine nacelle, where the propeller is mounted directly at the front of the engine. The difficulty is overcome by placing the propellers in back of the engine and driving them by a transmission shaft



© Kerston, New York

A 12-foot model of the Junkers flying wing

center section. There is no fuselage of the usual type and the passenger accommodations are to be entirely within the wing, with large "skylight" windows to provide lighting and illumination.

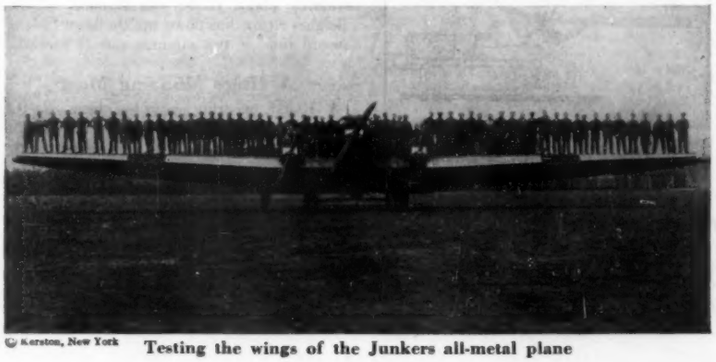
A special sound proof compartment is designed to minimize the noise of four 1,000-horsepower, oil-burning engines, to be built on the Diesel engine principle. Two rudders are fixed at the rear edge of the wing, and the elevator is to be carried on two horns or booms ahead of the wing. Wind tunnel results are said to have been entirely satisfactory.

Engineers are generally of the opinion that no matter how large an airplane must be, it must still have conventional forms for control and stability. Is the rudder control sufficient, seeing that the leverage of the rudders is so small? And the same question arises in reference to the elevators. Perhaps the idea is that a very large machine is more likely to keep on an even keel and normal flight attitude, and that controls need not have relatively the same power. But a great deal of both theoretical and wind tunnel investigation would be necessary before this viewpoint could be accepted.

A Vivid Strength Test

JUNKERS'S conception of the flying wing may be treated with respect because he does build excellent airplanes of more conventional type. The two illustrations show one of his latest planes, a large three-engined, all-metal airplane which is maintaining a service between Amsterdam in Holland and Malmö in Sweden. It accommodates 14 passengers in a roomy cabin and two pilots in a cockpit placed at the forward end of the fuselage.

It is customary to test airplanes by inverting them and loading them with piles of sand bags in a manner simulating the forces in flight. Placing 61 men on the wing is a vivid and imaginative method of demonstrating the strength of an airplane.



© Kerston, New York

Testing the wings of the Junkers all-metal plane

P. and A. Photos

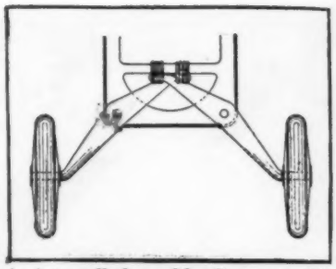
A good idea of the size of the Junkers three-engined, all-metal plane may be gathered from the small two-passenger plane standing under it

An Interesting Landing Gear

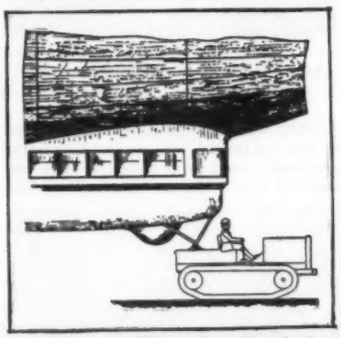
FOR many years designers have been turning their attention to internally braced wings, in which all external struts and wires disappear and the aerodynamic resistance of the wing truss is considerably diminished. The German engineer, Dornier, has extended this principle of internal bracing to the landing gear—which in the conventional type has an air resistance of 50 percent or more of that of the body of the airplane.

The principle of his landing gear is illustrated in the appended sketch from *Zeitschrift für Flugtechnik.* The landing gear has no axle and no bracing wires. Two very strong struts are the only projections from the fuselage to hold the wheels. These struts pivot about a pin which is hidden in the fuselage, and the rubber shock-absorber cords are also entirely hidden within the fuselage, as can be seen from the drawing.

The internal bracing and shock-absorption of the landing gear is a great advance in the aerodynamic refinement of the airplane.



An internally braced landing gear with the shock-absorbing mechanism in the fuselage so that resistance is reduced to a minimum



A heavy caterpillar tractor attached to the bow of an airship on the ground

A Tractor for Airships

THE handling of a large airship on the ground is always a difficult problem, which even the mooring mast does not solve entirely. A recent patent of the German Zeppelin Company suggests aid.

The airship is anchored at a point near its bow, by the intermediary of springs or other shock-absorbing devices, to a very heavy caterpillar tractor.

Flying Upside Down

THERE is no theoretical reason why an airplane should not fly upside down indefinitely. There must be sufficient power to counteract the inefficiency of the wing in such flying, the aviator must be physically capable of withstanding a flow of blood to the head, and the engine must somehow be supplied with fuel even though the carburetor is high above the main gas tanks. By the simple expedient of placing a tank of gasoline well below the fuselage on an Avro training plane, G. F. van Damme, of the Belgian Army, has flown upside down for the record time of two minutes and 27 seconds.

A Huge Mooring Mast

A HUGE mooring mast has been erected at Cardington, England, which is to be the English terminus for the projected British Empire airship service, in which airships of 5,000,000 cubic feet are to be employed. This mast is no longer the slender structure that was once customary, but a broad and solidly braced tower, 200 feet high. It is to be provided with passenger elevators, so that passengers will experience no discomfort in finding their berths aloft.

Hadel & Herbert

A huge mooring mast erected at Cardington, England, to serve as the English terminus of the projected British Empire airship service

An Alaskan "Dry Land" Gold Dredge

Often people's love of creating some kind of mechanical contrivance that they can call all their own leads them astray as to its economic practicability. A reader in Seattle, who recently returned from a prospecting trip in Northern Alaska, sends us the photograph of a contraption which illustrates this point. It is a "dry land" dredge, designed to dredge gold on dry land.

Scientific American,
Gentlemen:

Apparently some old "Sourdough," observing the enormous amount of gravel dug up by large million-dollar gold dredges, conceived the idea of a dredge to operate on dry land. Cleary Creek, richest of the Fairbanks gold-mining district, if not of all Alaska, was selected for the "experiment." The tailings piles, from which $26,000,000 had been sluiced, remained upon the surface and were expected to yield as a "pay-streak."

Those who are at all familiar with dirt-excavating machinery will readily note the several buckets to the left, which elevate (or were designed to elevate) the "pay-dirt" to a hopper, the "grizzly" or revolving screen which receives the material and sorts out the gravel, and the conveyor belt which disposes of the coarse stuff which is too large to drop through the screen into the gold-sluice below. The boiler to the right furnishes steam to operate an engine which drives the mechanism and pumps water into the screen and gold-sluices.

The contraption, as is true of most of these impracticable freakish devices, was not a success and has been abandoned.

The gold-bearing creek channels among the barren hills surrounding Fairbanks have produced $90,000,000 to date.

M. H. Guise.

To Tell Precise Solar Time

Mr. Hawkesworth, who is the originator of the method of telling solar time described in a letter contributed to our January issue, gives us his final and authoritative determination on this interesting subject:

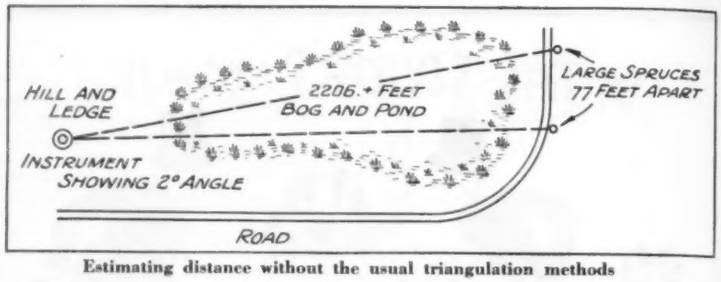
In the Northern Hemisphere: Imagine a huge clock-face around the Pole Star, with 12 above, and six below—in the usual fashion. Take as our hour hand upon this imaginary clock-face the two stars called the "pointers" of the Great Bear or Dipper. Read the hour indicated thereby, and add to it the number of months, and fraction of a month, elapsed since January 1. Double this sum, and subtract it from 52¼ or 28¼ or 4¼, the test for which of these three Constants we must use being that the remainder must be positive, yet less than 24. The result will be the true solar time—reckoned from midnight—with 12 to 24 for P.M. time.

For example: on the evening of September 27, being 8.9 months after January 1, the two pointers are at 7 upon our imaginary clock-face, the Dipper being below, and to the left of the Pole Star. Doubling 7 + 8.9 gives 31.8. Subtracting from 52.25 gives 20.45. So that our solar time is 20 hours 27 minutes, or 8 hours 27 minutes P.M.

In the Southern Hemisphere: Again imagine a huge clock-face around the South Pole, with 12 above and six below. And for our hour hand take the two stars *(alpha and gamma Crucis)* forming the upright of the Southern Cross, since these point almost precisely to the South Pole. Read the hour indicated by the slope and direction of the said two stars; and subtract the number of months and fraction of a month, elapsed since January 1. Double this difference, and if the remainder be positive, add it to 6, or if it be negative, subtract it from 30. The result will be the true solar time—reckoned from midnight—with 12 to 24 for P.M. time.

For example: on the evening of July 9 the Southern Cross lies on its side to the right of the South Pole, so that its upright indicates 3 upon our imaginary clock-face. The elapsed months are 6.3, which subtracted from 3 gives us −3.3—a negative. Doubling this, and subtracting it from 30 gives 23.4. So that our

What is it?



Estimating distance without the usual triangulation methods

solar time is 23 hours 24 minutes, or 11 hours 24 minutes P.M.

In countries on or near the equator the Poles are on the horizon, so that the Great Bear and the Southern Cross will be below the horizon in the autumn months. In which case we can turn to Cassiopeia's Chair and, choosing *Gamma*, the star forming the midmost peak of the "W," imagine a line connecting it with the Pole Star as our hour hand. Add the indicated hour to the elapsed months, and fraction of a month. Double the sum, and subtract it from 18.13 or 42.13 or 66.13. The result—positive and less than 24—will be the true solar time—reckoned from midnight—with 12 to 24 for the P.M. hours.

This use of the Great Bear, or Cassiopeia's Chair, or of the Southern Cross, as a convenient timepiece to check off the long hours of a night watch may commend itself to seamen. But a more valuable use would be to determine a ship's or small boat's position during stormy or cloudy weather when a sun observation at noon was unobtainable, since even a momentary glimpse of these easily recognizable stars would be sufficient at any time during the night. To increase our accuracy in measuring their slopes, or indicated time, we could use, say, a small piece of window glass, diamond scored with the angles in a quadrant, or even marked 30°, 60° and 90°, with soap or tallow. Whereupon, of course, the difference between the true solar time, so obtained, and the known time of any other meridian, given by radio, the ship's chronometer or even a good watch, and that difference multiplied by 15, would at once give us the number of degrees of longitude we were west or east of the said known meridian. The result would, no doubt, be merely approximate, but it would be vastly better than a wildly guessed-at dead reckoning. It would be priceless to shipwrecked mariners, wind-driven for days in an open boat.

Alan S. Hawkesworth, F. R. S. A.

Must We Cease Using Them for Bait?

We do not remember ever having read an ode to the lowly worm, but since receiving a photograph from Paul E. Denton, showing the artistic tendencies of the species, we think the poets ought to get busy.

Editor, Scientific American,

Dear Sir:

Do worms have a sense of the artistic?

It would seem that they do, judging by a wonderful design made by them on the under side of a piece of bark picked up by Harry Stanton at his home in Chardon, Ohio.

Stanton was putting some wood in the fire when a large piece of bark fell from a slab. He noticed a beautiful design on the bark.

It was as if some artist had carefully planned and executed it. The appearance of the design looks as though it had been burned into the wood by some expert pyrographer.

"I have been a farmer for many years and this is the first time I ever saw such a remarkable thing," said Stanton. "The piece of wood is attracting considerable attention. There were many worms in the wood at the time I found it. You may be sure that I baked the wood to be sure they were all killed."

Paul E. Denton.

A Surveyors Short-Cut

That Editors are not omniscient is proved by the following:

Editor of the Scientific American:

Dear Sir: I wrote in the spring inquiring if there was any "off hand" rule to work triangulation without logarithms, etcetra, and your reply was negative.

Now, if one loses his logarithm tables, he can depend on getting out of his dilemma by using two factors that can easily be remembered and which most educated schoolboys have in their heads, namely: Remember number of degrees (360) in a circle and the pi (3.1416) relationship of circumference to diameter. These require no elaboration to use and should be used by a method known as the "Noyes Rule"; (for simple field use it works to a minute accuracy for anything within five degrees), thus: with the vertex of the angle given and the length of chord, find distance of radii, i.e. distance of apex from the ends of the base. Rule: divide the degrees

The design on this piece of bark was made by worms

in the circle (360) by the angle; multiply the quotient by the chord (which gives the circumference of circle); get the diameter by dividing the circumference figures by 3.1416 and then halve (divide by 2) this for the radius, or distance from the angle to the chord. This method was thought out by the incident diagramed on this page.

This principle can also be applied to find either of the other two distances.

Anyone who loses this rule can easily grasp the idea and work it out, since its philosophy, when once understood, is simple. Field surveyors, and especially ordinary compass surveyors, find this rule very valuable as well as a great saver of time and expense where valleys, swamps, ponds, et cetera, are in the course of suvrey when no logarithms are at hand.

Dr. B. L. Noyes,
Stonington, Maine.

P.S.—I did surveying when a young man and devised this method years ago.

Another Approving Reader

The following letter speaks for itself. We are glad to have Mr. Foster's words of commendation.

We were sorry to be obliged to tell Mr. Foster that we do not know the whys and wherefores of the naming of Muscle Shoals—except that the shoals in the Tennessee River which mark the site of this much-talked-of development have been known locally for a long time by that name.

Editor, Scientific American,
Dear Sir:

In reading my December Scientific American, it surely did me good to see someone give this eternally, execrable and as he puts it, "personally detested" continued-on-page-seventy-eleven, column —— till you tear your hair. Give it, I say, a good rap. It is analogous to a person sitting down to a table, ordering a meal, having a part of it served and after eating that serving, being informed that if he is still hungry and if he does not mind the inconvenience, he will find the remainder of his order in room number ——.

Like Mr. Lake, I, too, read the advertisements in the Scientific American. You would find in my copi. many of the lines underscored, for they contain real information, and often beautiful language, making modern advertising almost, if not quite, a science. For example, "New York-to-Chicago telephone cables completed, cost $25,000,000, and would take ten lines of poles, each heavily loaded with wires, to carry the circuits contained in this most modern artery of speech." Or, in the advertisement "Cruising to the Caribbean," "Cruising is the only kind of travel that means absolute rest. Long luxurious days at sea, among new and strange peoples who are content with little; lands that blaze with exotic color where stately palms mark the line between dazzling white coral and amethyst sea, et cetera." Worth reading? Well, I think so.

Another thing I have been wishing to know, ever since the periodicals began writing about the development of "Muscle Shoals," is why it is called "Muscle Shoals." Isn't the word "mussel," which I believe is a mollusk of the bi-valve variety, more apt to bring to our minds river development? Or are they named from a man by the name of "Muscle?" From some cause, it has always jarred my nerves like a discordant note in music. Imagination? I wonder.

Homer Foster.

Who Else Saw This Meteorite?

In the February issue of the Scientific American, Prof. Henry Norris Russell told how to trace the path of a meteorite. Two observers should see it from rather widely separated points of vantage, after which its actual path can be worked out by geometry. Did anyone else observe the fall of the meteor described in the following letter?

The Scientific American,
Gentlemen:

Herewith I am enclosing details of the transit of a meteorite which I observed at Yucca, Arizona, a way-station on the Santa Fe Railroad, about 18 miles south of Kingman, Arizona.

It appeared just below Arcturus (west) at a point on a direct line between Saturn and the north, one of the pointer stars in Ursa Major. The transit was from this point to the star cloud of the Milky Way in the tail of Scorpio.

Time, 2:28 A.M., May 1st, Pacific Time: Duration of transit 36 to 40 seconds. This computed by repeating a verse which requires 6 seconds to say and was repeating it the seventh time when the meteorite faded from view.

Its color was about that of the flame from an ordinary wood fire and it resembled in a small way a skyrocket in that sparks were projected behind from it in its flights. Its glow was rather much less than is usual with other meteorites I have observed.

Sincerely,
J. P. Byers,
Winslow, Arizona.

Great Whirlwinds

Few of us have ever seen a tornado, often misnamed "cyclone," but far fewer have been in at the actual birth of a group of them. Here is an interesting letter from one of our readers who saw one form and split into several lesser whirls, each of which sped on its devastating way.

Scientific American,
Dear Sirs:

Never having read of anyone being actually present at the birth of a tornado, but reading several accounts of how they are formed I, having the privilege of being immediately beneath one, think I should make a record of it for you to pass along to some one to whom it may prove of interest.

Owning a farm situated some five miles southwest of Falls City, Nebraska, it is my custom to visit it in May and September each year, upon which occasion it is customary for the man who runs the farm to give a big family dinner on Sunday at which from 35 to 45, big and little, are present.

Some 20 or more years ago while we were at table, we heard a moaning sound in the sky which sounded like the moan of a sick dog, and we were all fully impressed with a feeling that something was about to tear loose above.

We ran out, and the sky was a sight. Clouds were rushing at great speed in different directions. We hustled the women and children into a cave and the men ran out into a pasture east of the house.

When I got out with the men and looked up, I saw that there were four different directions to the air currents, each one at different altitudes. As I looked up, I found I was exactly under a piece of blue sky that formed a perfect square, with perfectly sharp corners.

As we watched, it seemed that the different currents of cloud were gradually approaching each other and the corners of the square began to round. Suddenly, with a zip, a small tornado broke away and sped just a trifle north of east, taking several panels of my east and west fence as it crossed it. In a short time another small one with the same sound—zip—started, going but a few points farther north than the first, and then with a mighty roar, the big fellow let go and went about northeast. This big one was heard of afterwards through newspapers as passing over into Missouri.

We surely felt relieved when we found that none of them had hit the ground closer than a half-mile from us and, as we were congratulating each other and calling the women and children from the cave, we were hit by a big hail storm. Hail like golf balls peppered us for a short time and then came a big rain.

This is my recollection of this occurrence, and I am sorry someone with more knowledge of "cloudology" was not present to describe it more in detail.

Mr. D. R. Grush and his entire family were witness to this. He resides at Falls City, Nebraska, and can substantiate all I have written in case this experience should need any confirmation.

C. H. Conklin,
Decatur, Illinois.

Science and Money

Preferred Stocks

By Henry C. Trundle

THE preferred stocks of companies with a long established record of dividends on their common stocks may be regarded as reasonably safe and, as they frequently give a higher return on an investment than the bonds of the same companies, can be purchased advisedly if income is preferred to absolute security. While bonds fluctuate in price but slightly even though sales or purchases in the market may be large, the same volume of business in the preferred stocks usually will result in a variation in price of several points. Investors who are easily frightened when the quotations of their securities drop precipitately, for their own peace of mind should confine themselves to bonds rather than undertake the risks which attend stocks. Otherwise sound preferred stocks are most desirable.

The financial structure of a company ordinarily consists of bonds and stocks. Stated in another way, a company obtains its capital from creditors and from partners—the former being the bondholders and the latter the stockholders. The difference between owning a half or quarter interest in a concern or owning one hundred shares out of a total of fifty thousand shares in a corporation is just one of degree. Of course, in the first instance the relationship may actually be closer, but in the final analysis the relative position is exactly the same.

Preferred Stocks Have Prior Claim

As the name suggests, preferred stocks have a prior claim, compared with common stocks, as to dividends and as to assets in the event that a company is dissolved. Because of this advantage dividends are limited in amount and the stocks are bereft of any great speculative possibilities. It is true that the shares may in time become so highly regarded that they will sell strictly on an investment basis, resulting in an appreciation of several points, but other than this not much action is to be expected marketwise unless one takes the viewpoint that conditions will warrant the stocks selling at a much lower figure.

There are different types of preferred stocks just as there are various kinds of bonds. The simplest form is the straight preferred stock which has a first claim to dividends but which can only be paid out of current year profits. In good years and if a company has a sufficient earnings power this arrangement is entirely satisfactory. Some companies run into difficulties every few years and, although a large surplus may have been built up from which dividends could be paid, they cannot be paid because current year earnings do not permit it. Obviously it is not fair to preferred stockholders to limit their dividends in good years and to discontinue them in bad years when the surplus would warrant full payments. It was to correct this situation that "cumulative" preferred stocks were devised.

Cumulative Preferred Stocks

Cumulative preferred stocks are those upon which the dividends accrue and which, if the dividends are at any time earned, must be paid before disbursements can be made upon the common shares. Some persons who have striven for a large income and therefore have purchased preferred stocks in preference to bonds have had the unfortunate experience of having to do without any income at all when their companies met with reverses. The cumulative feature partly relieves this situation if the company has the ability to ultimately earn amounts sufficient to pay off accumulations and to resume regular payments.

For a period following the war the rubber companies, certain railroads and other companies found it impossible to continue dividends. When fortune turned, these companies were several years behind in dividend payments, and although they were able to pay at current rates, they were prohibited from doing so until the arrears were paid. Various arrangements were resorted to—the exchange for additional new stock, the issuance of dividend script notes, full payment in cash or part cash and part stock, either preferred or common. Possibly there has been but a slight loss in income, if any, but certainly it has been most embarrassing to shareholders to be without any income in the very times when such income was especially needed. However, back dividends are finally being paid up.

Preferred Stock May Be Exchanged

It may also be the desire to permit the preferred stockholders to share in excessive earnings. This is arranged through a clause providing that the preferred stocks shall participate in such earnings to a stated amount after the common shares have received dividends. Sometimes these two classes of stock will share the balance to the same amount or the preferred will share only up to say three percent, the balance being applicable to the common. This participation feature is quite common and many stocks are actually paying several dollars extra in this way.

Still another class of preferred is the convertible preferred which may be exchanged for other securities, usually the common stock. This stock gives the holder an opportunity to speculate mildly for it later may be advantageous to switch into the common if dividends and the market price warrant it.

Employee-Customer Ownership

In recent years public utility companies have obtained large amounts of capital through the sale of preferred stocks, either through customers ownerships campaigns, or through banking concerns. Offerings of industrial shares also have been numerous, while the railroads have done very little of this type of financing. The idea that stock should be sold directly to the people that are served, which has been developed so highly by the public utilities, has revolutionized business and removed much of the cause of socialistic complaint. At the present time practically every company of any size attempts to interest its employees in it in a financial way through the ownership of its stock. Because of the local nature of the business public utilities are enabled to make almost as strong an appeal to their customers. Manufacturing concerns and railroads are also trying to attract customer investment, as well as employee, but the problem is a greater one due to the broader market. This employee-customer ownership of companies makes it easier to raise capital and does much to avoid labor and anti-legislative troubles.

An issue of preferred stock may be offered to the public solely on its own merits based upon the earnings record and the popularity of the company. On the other hand it may be necessary to "window dress" the stock through the addition of common stock bonuses or of warrants giving rights of one kind or another. These latter features are common in the case of a new or unknown company or when market conditions make it necessary to add a speculative flavor.

The value of a preferred stock may be ascertained by determining its book value, or the equivalent of assets over liabilities which is behind it. It is not practicable to capitalize the earnings per share, as the dividends are limited to a fixed amount. A comparison of earnings records, surplus

accounts, operating ratios, and similar financial data of companies engaged in the same general type of business will also give a fairly definite idea of the worth of a stock under consideration, keeping in mind of course the dividend rate and the market price.

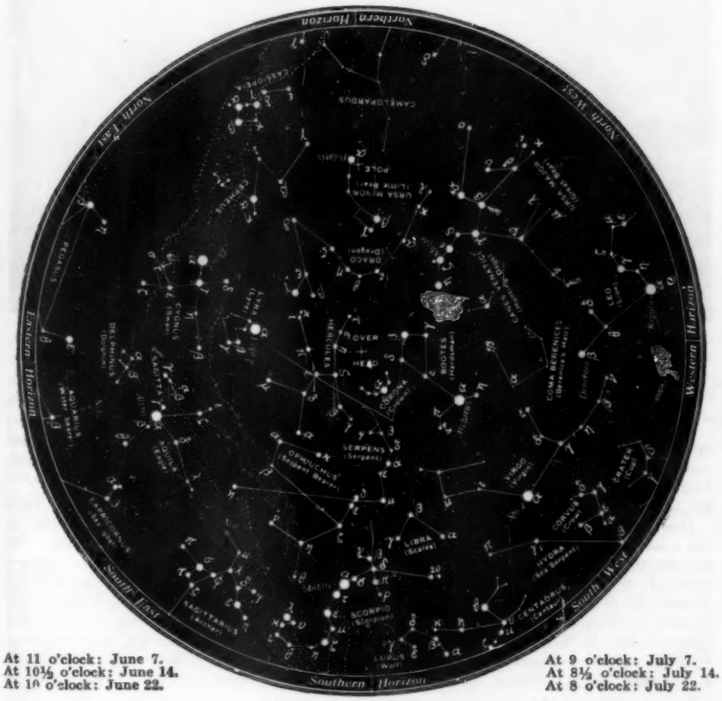
Because of the stabilized nature of the business and the long record of dividends paid on both the preferred and the common, it would appear that the preferred stocks of public utility companies offer unusually good investment values. Although dividends have been paid regularly for years at the rate of $7.00 or seven percent per share many utility preferred stocks are selling at between 90 and 100, giving a return of around seven and eight percent—a most attractive yield considering that the bonds of these same companies yield less than six percent.

Until now no great market sentiment has been built up for utility preferred shares which probably accounts for their selling at prices so much at variance with their value. The preferred stocks of most railroads and some industrials sell on an investment basis, that is, at a price to yield five or six percent. The business of manufacture and distribution is so hazardous, however, that the preferred stocks of such companies are usually regarded as suitable for purchase only by persons in close touch with economic conditions.

Since preferred stocks have neither the security of bonds nor the speculative possibilities of common stocks, they are to be purchased principally when only income and relative security is desired. The inclusion of a few sound preferred stocks in a well balanced investment account will generally increase the average rate of return.

The Heavens in June

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: June 7.
At 10½ o'clock: June 14.
At 10 o'clock: June 22.

At 9½ o'clock: June 30.

At 9 o'clock: July 7.
At 8½ o'clock: July 14.
At 8 o'clock: July 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on June 7, etc.

NIGHT SKY: JUNE AND JULY

The Heavens

THE finest part of the sky is now in the east, where Cygnus, Lyra and Aquila are to be found, and the southeast and south, marked by the great star-clouds of Sagittarius and the brilliant constellation, Scorpio.

Hercules and Ophiuchus, almost over head, are less conspicuous; but Boötes, Virgo and Leo brighten up the western sky. Ursa Major is high in the northwest, and Draco and Ursa Minor in the north, while Cepheus and Cassiopeia are in the northeast and lower down.

The Planets

Mercury is in conjunction with the sun on the 4th, and is visible only near the end of the month, when he sets at 9 P.M. Venus is a morning star, rising before 3 A.M. and very conspicuous. Mars is still a morning star, though he rises but a few minutes after midnight by the end of the month. He is in Pisces, not far from the vernal equinox, and is a conspicuous object, as bright as Procyon or Rigel.

Jupiter is past quadrature and comes to the meridian at 4 A.M. on the 22d; but, being 13 degrees south of the equator, he does not rise until a little before 11 P.M.

Saturn being just past opposition, is the most conspicuous of the planets, and is in sight almost all night.

Uranus is in quadrature on the 21st and may be observed in the morning. Neptune sets at about 9:30 P.M. in the middle of the month, and is scarcely observable, since so faint an object should be high for good telescopic study.

The moon is in the last quarter at 3 A.M. on the 3d, new at 5 A.M. on the 10th, in her first quarter at 6 A.M. on the 18th, and full at 4 P.M. on the 20th. She is nearest the earth on the 1st, farthest off on the 16th, and in perigee again on the 28th. During this month she is in conjunction with Jupiter on the 2d, Mars on the 3d, Uranus on the 4th, Venus on the 6th, Mercury on the 10th, Neptune on the 15th, Saturn on the 22d, and Jupiter again on the 29th.

At 11:30 P.M. on the 21st, the sun reaches the farthest north, and "summer begins."

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

International Newsreel

E. A. Brown, of station 2CV, Richmond Hill, N. Y., has made arrangements to communicate on regular schedules with the operators of the Byrd polar flight. Short wavelengths will be used

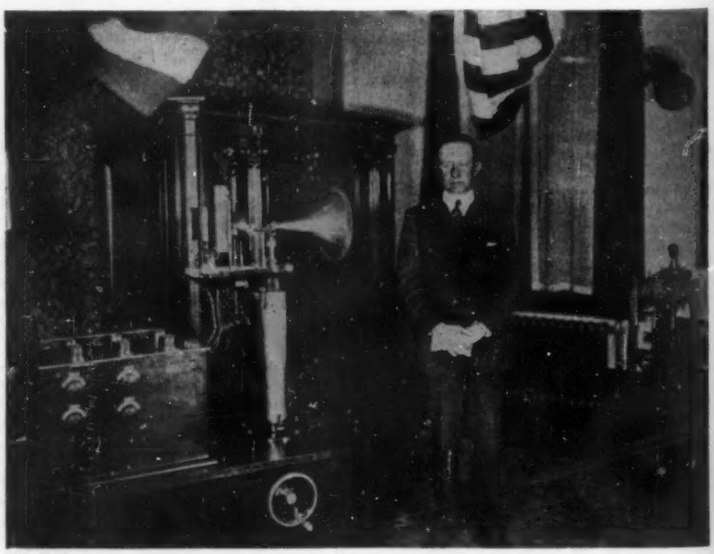
How to Select a Good Battery

THE National Better Business Bureau calls attention of radio fans to the fact that the capacity of a storage "A" battery cannot be judged by the size of the case, weight of the battery or by the specific gravity.

How can the consumer play safe in buying a storage battery? The Business Bureau answers this question, "By buying the products of trustworthy manufacturers from trustworthy dealers."

After a survey of the markings on storage batteries sold in New York, the Bureau issued the following report: "The makers of 85 percent of the storage batteries have pledged themselves to follow a code which protects battery buyers. Leading retailers have adopted a corresponding policy in advertising and selling. With such concerns, battery buyers can deal with confidence.

"A few manufacturers and some radio dealers have failed to display a similar interest in the protection of the public. The popular tendency to regard a storage battery somewhat as a box of mystery has encouraged the marketing of batteries unmarked as to capacity, and so designed that the buyer may overestimate their capacity. Some manufacturers have marketed batteries in oversize boxes or jars. Also, in certain



Wide World

Marconi, the inventor of wireless, standing before the transmitting equipment of an Italian broadcasting station. Note the horn of the microphone, which is not used by American or British stations

Kadel & Herbert

This short-wave receiver has been taken by F. Gow Smith, of the Museum of the American Indian, into the wilds of Brazil where he will study the South American Indians. He expects to hear the short-wave signals of KDKA, WGY and amateurs in the United States. J. B. Brennan, set builder, is on the left and Mr. Smith is on the right

instances, radio dealers have employed inaccurate advertising and selling representations to enhance affirmatively the impression created by the oversize boxes."

It is pointed out that the essential requirement of a storage battery for radio use is that it shall deliver sufficient power over a reasonable period of time. The capacity of storage batteries is rated in ampere-hours. The ampere-hour is that quantity of electricity which flows in one hour through a circuit carrying a steady current of one ampere. It is the ampere-hour capacity, not size, nor weight nor number of plates, which determines a storage battery's value to a radio set owner.

The capacity of the battery depends upon the amount of active material which the battery contains. The integrity and skill of the manufacturer determine how efficiently the lead plates and the acid solution which constitute the active battery elements are proportioned to each other. The size of the container is a poor indicator of capacity. A large box may contain less active material, and therefore have less capacity than a small box equipped by another manufacturer. Weight is an uncertain indication. A large jar full of acid and containing seven plates per cell may weigh more than a nine-plate battery built in a smaller box, but containing a larger quantity of active materials and thus having the greater capacity.

Nor is the number of plates a good criterion of a battery's capacity, because the plates of two batteries may differ in dimensions. For example, various types of storage batteries, each having a capacity of 100 ampere-hours, have been designed for radio purposes. One has nine plates, another eleven, another thirteen, respectively. Each has a true capacity of 100 ampere-hours. Each is a good battery.

Medal for Saving Life by Radio

Popular Radio has established a Medal to be awarded for conspicuous service to non-

Kadel & Herbert

Uschichiro Tokumi and his radio clock, which can be attached to any set to automatically turn off the receiver and on to pick up any particular features the owner may wish to hear. By turning an indicator to the hour at which the set is to be started, an electric circuit will be closed at that time and the receiver placed in operation

Harris and Ewing

The laboratory of the Bureau of Standards has devised apparatus for determining the distance over which receivers may be expected to give service under all conditions. "Complete service area" means the radius over which reception is possible the year around without trouble from fading or static

professionals who, through prompt and efficient radio action, perform an essential part in the alleviation of human suffering or in the saving of human life. This medal will be awarded to as many individuals as qualify for it and at such times as the Committee of Awards may authorize.

Nickel-in-Slot Radio Makes Appearance

A RADIO receiver which operates on the nickel-in-the-slot principle has been developed by Joseph Pinto, of Philadelphia. It is a five-tube circuit, designed for operation with batteries or by direct connection with the house-lighting mains. A red light flashes to indicate the expiration of the time allowance one minute before it is up.

Setting-up Exercises on the Air from WLS

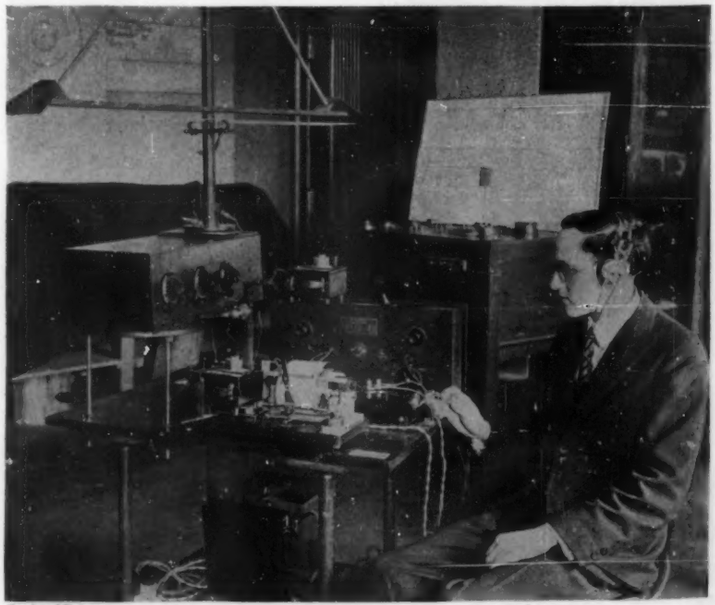
STATION WLS, Chicago, has been added to the list of transmitters broadcasting setting-up exercises. The physical director goes on the air at 6:30 o'clock in the morning under the auspices of the Y. M. C. A. A second exercise period begins at 7:00 o'clock; and at 7:30 o'clock, the Family Worship League holds its meeting over the radio. This service is conducted by the Chicago Church Federation, one minister doing the broadcasting for a week at a time.

Features Embodied in WGBS Equipment

SEVERAL new features in transmitter design are embodied in the installation of WGBS, which has been removed from New York to Astoria, Long Island. The studio is in New York and is connected by land wires with the broadcasting apparatus.

The operator can now control the entire transmitting system by four lever switches, thus eliminating seventeen relays from the control equipment.

A new pilot system has also been installed; if any fuse or circuit breaker opens, pilot lamps and bells operate to reveal the exact location of the trouble. The station is equipped with an automatic tape-recording device which gives the operator a permanent



Harris and Ewing

This apparatus in the laboratory of the Bureau of Standards measures the intensity of the broadcasting stations. Many of the stations are expected to increase their outputs during the summer months to combat static and the long hours of daylight

record of all SOS signals and ship calls on the 600-meter wavelength. Another device automatically takes the transmitter off the air should it vary from its assigned wavelength.

Ground connections are made to 2,000 square feet of copper plate beneath the East River. The aerial is strung between two wooden masts 200 feet above the river. The aerial wires can be lowered to the roof by a dual-motor system. There is a motor at each mast and by pushing a button these motors lower the aerial at both ends, so that it can be repaired or ice-cleared from the wires without delay. A high-powered windmill is part of the equipment and is used to charge the batteries. If there is little wind, the batteries are automatically relayed to a charging transformer.

The site of the station is a small peninsula opposite 90th Street, Manhattan.

WGY'S Net Extends Across the State

STATION WGY has extended its wire network across New York State so that programs can be picked up from Buffalo, Rochester, Syracuse, Schenectady, Albany, Poughkeepsie and New York. Station WMAK, Lockport, represents the western terminus and through its Buffalo studio, programs are forwarded from that city to the Schenectady transmitter. WHAM represents Rochester in the circuit, WFBL, Syracuse, and WJZ, New York. Entertainment originating in any of these cities may be broadcast simultaneously by all stations in the chain. Canton, New York, is linked to the circuit by radio relay on 1,560 meters through station WCAD.

Lodge Says He Can Stop Radio Howls

SIR Oliver Lodge has announced that he has solved the problem of preventing radiating receivers from stirring up the ether with howls which interfere with neighbors. It is understood that his method dispenses with antenna tuning and thereby stops radiation. Reports from England say that the new discovery will not add to production costs and that the millions of receivers now in use can be altered so as not to act as miniature transmitters.

Exports Increase

EXPORTS of radio equipment from the United States during 1925 exceeded all previous years, according to preliminary figures. The figure for last year is placed at $9,903,787; for 1924, $6,030,914; for 1923, $3,448,112 and for 1922, $2,897,779.

In 1919, before broadcasting began, the entire exportation of telegraph instruments, including wireless, amounted to only $830,887.

Uncle Sam's best radio customers in 1925 were: Canada, $3,682,483; Japan, $2,216,535; Australia, $675,483; the United Kingdom, $644,916 and Argentina $408,593.

Radio broadcasting made considerable progress in Japan last year, as indicated by the fact that Japan reached the $2,000,000 class. That country imported only $35,822 worth of radio instruments in 1924.

Farmers Like Radio

RADIO receivers on farms in the United States now total approximately 1,000,000, according to the latest estimate of the Department of Agriculture. There were about 145,000 sets on farms in 1923, according to the Department's figures, 365,000 in 1924, and 553,000 in 1925.

Neutrodyne Report

THE annual report of the Hazeltine Corporation shows that during 1925 its licensees under the neutrodyne circuit patents did a total business of $11,895,339. This figure represents the net amount received from the distributing section of the trade, and not the actual amount paid by the public.

The operations of the company, according to its profit and loss statement for 1925,

shows that the profit for the year, after provision for Federal income tax, but before providing for amortization of patents, was $436,058.

A total of 261,416 neutrodyne receivers were sold during 1925 by the fourteen licensees of the Hazeltine patents. This figure is exclusive of kits containing parts for assembling the circuits at home.

Advice to Youth

IT is the opinion of W. H. Priess, President of the Priess Radio Corporation, that the young engineer graduating from college, if interested in radio, should associate himself with a small, compact organization in preference to a large, highly organized concern.

He said, "A small organization is preferable to a large one, because it offers an opportunity for a broader training. In the big organization the assignment would be to a detail of a circuit, such as the proportioning of a transformer or condenser, whereas in the small laboratory, experience would be derived on the entire circuit and its interaction.

"In a big organization the opportunity is seldom offered to study a completely rounded problem. All is specialization in the large laboratory. Nor does the big concern offer the individual the benefit of variety in problems; whereas in the small organization, the variety may be as wide as the field itself, offering its workers circuit problems, any and all.

"Furthermore, the small organization is more likely to develop quickly the 'commercial sense' in its engineers. This is highly important for individual advancement. I use the term in distinguishing between that type of man who enjoys a problem purely for its own sake and the type of man who works on a problem with the thought of its commercial application definitely in mind. The latter is more likely to be developed in a small organization and, naturally, will earn a larger income. The man in the small but efficient laboratory is more likely to develop initiative.

"In two years, on the average, the college recruit should be a fairly good man," said Mr. Priess. "If he has been with one of the smaller organizations he should be a better man than his colleague who went into the large concern."

It is pointed out that much depends upon the man himself. Some engineers can progress more rapidly as a "lone wolf," but others are better adapted for work with a group.

10-Meter Waves Not Suited for Communication

WAVELENGTHS below 10 meters pass off into the infinite and therefore are not suited for communication on the earth, according to Dr. O. E. Hulbert, of the U. S. Naval Research Laboratory, who described the vagaries of the ether to the Franklin Institute. He also said that waves in the neighborhood of 200 meters are not efficient as carriers of broadcast entertainment.

Additional Beacons To Be Established

RADIO beacons have been ordered for the Hawaiian Islands and Alaska; and it is planned that a low-power beacon will be installed on Long Island Sound. Additional beacons will soon be established at Portland, Maine, Los Angeles, Grays Harbor, Washington, and on Lake Michigan. There are now twenty-four beacons in operation along the shores of the United States.

Theatre Program from Seven Stations

STATION KSD, St. Louis, has been linked into WEAF's chain to broadcast the musical program from the Capitol Theatre on Sunday nights from 7:20 to 9:15 P.M., Eastern Standard Time. The network now includes: WEAF WCAP, WJAR, WWJ, WCAE, WEEI and WTAG.

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SIR OLIVER JOSEPH LODGE

English physicist, was born at Penkhull, Staffordshire, on the 12th of June, 1851, and was educated at Newport (Salop) grammar school. He was intended for a business career, but being attracted to science he entered University College, London, in 1872, graduating D.Sc. at London University in 1877. In 1875 he was appointed reader in natural philosophy at Bedford College for Women, and in 1879 he became assistant Professor of applied mathematics at University College, London. Two years later he was called to the chair of physics in University College, Liverpool, where he remained till, in 1900, he was chosen first principal of the new Birmingham University. He was knighted in 1902. His original work includes investigations on lighting, the seat of electromotive force in the voltaic cell, the phenomena of electrolysis and the speed of the ion, electromagnetic waves and wireless telegraphy, the motion of the aether near the earth, and the application of electricity to the dispersal of fog and smoke. He presided over the mathematical and physical section of the British Association in 1891, and served as President of the Physical Society in 1899-1900 and of the Society for Psychical Research in 1901-1904; President of the British Association, 1913-1914; Albert Medallist of the Royal Society of Arts as the pioneer in wireless telegraphy, 1919. His recent works on the Atom and Ether are well known.

Elements of Alternating Currents and Apparatus
By J. L. Beaver
Asst. Prof. Elect. Engr., Lehigh Univ.

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Elements of Radio Communication
By E. W. Stone
Lieut.-Comdr. U. S. N. R.

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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Don'ts for Inventors

WHEN an invention is made it is the latest word in its particular field, but it is by no means the last word. Inventions, especially in new fields, are usually far from being perfect and they lend themselves readily to improvements. Often an apparatus or a process can be made far more valuable by means of an additional invention which makes for cheaper operation, increased production or superior quality of the output. Such a patented improvement might be sold profitably either to a rival concern or to the manufacturer controlling the invention upon which you improve. *Don't overlook the inventive possibilities in improvements.*

Remington Wins Patent Suit

THE Court of Appeals of New York has recently handed down a decision in one of the most interesting cases involving patents to be brought into the courts in recent years. The decision, upholding the right of the Remington Arms Company to cash register patents claimed by the National Cash Register Company, gives assurance of continued employment to approximately 3,000 workmen of the Remington plant at Ilion, New York.

The entire case revolved about Frederick F. Fuller, known as the oldest cash register inventor in the United States. Fuller had been employed by the National Cash Register Company at $5,000 a year under a contract for one year beginning in 1909. He agreed to transfer to the company all cash register mechanisms made by him during his employment, and if at the end of the contract he left the National's employ, not to enter the service of any other cash register company for a year following the severance of the connection. Any inventions he might make within that one-year period he was to assign to the National Cash Register Company. Shortly after the contract expired Fuller asked for a new term contract. It was refused.

Probably no business in America is more dependent for its growth and its continued life upon patents than the cash register business. The Remington Arms Company is said to have spent $1,500,000 in developing the Fuller cash register, of which it has manufactured 58,000. It is estimated that an adverse ruling would have meant a loss of $3,000,000.

The Right to Your Own Name

THE right of any man to use his own name in the conduct of his business has generally been recognized as a rule without exceptions. That there may be exceptions even to this rule, however, was reiterated recently when the New York Supreme Court decision, prohibiting Paul Westphal from using the name "Westphal" in business, was upheld by the Appellate Division.

The suit was brought by Paul Westphal, Inc., against Paul Westphal and others. Both parties manufactured a hair tonic similar in color and put up in containers that were much alike. The tonic had its origin when Paul Westphal, a German immigrant barber, put it on the market and called it "Westphal's Auxiliator." His executors incorporated the business in 1910, after his death. The present Paul Westphal is the grandson of the founder.

"After reading the evidence in the case," the court holds, "we are convinced that the defendants have not acted honestly, but have illegally appropriated the name 'Westphal's' and have sought by advertising and by putting out their goods, to destroy the plaintiff, and, through fraud and deceit, to deprive it of a property right which the plaintiff through long years of hair tonic manufacture, and in advertising the same, and in dealing with the trade, had acquired."

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

FLYING MACHINE.—Of the type adapted to be operated by man power, or may be driven by an engine in the usual manner. Patent 1569794. L. Weil, 160 Claremont Ave., New York, N. Y.

AEROPLANE.—Provided with a combination of devices for steering and elevating or lowering the plane, or for stopping the plane in a short space. Patent 1575286. J. F. D. Smith, Georgia School of Technology, Atlanta, Ga.

STRUCTURE AND COMPOSITION OF THE FUSELAGES AND PARTS DEPENDING THEREON FOR AEROPLANES.—Comprising also a particular arrangement of the controlling members for the rudders and the skid, and conferring to the single parts a great resistance. Patent 1578073. G. Caproni, U. Nobile and R. Verduzio, c/o L. Laboccetta, Via Due Marcelli 31, Rome, Italy.

Electrical Devices

LAMP SOCKET HOLDER.—Especially designed for the purpose of attaching and supporting electric lamps on Christmas trees. Patent 1574695. W. A. Riley, 2 Manhattan Ave., New York, N. Y.

MULTIPLE JACK AND SWITCH.—In which the filament switches and plate circuit switches are operated simultaneously by movement of the plug. Patent 1574158. L. A. Krejci, 1523 W. 18th St., Chicago, Ill.

SIGNAL CANE.—Wherein means are provided for presenting an electric lamp adjacent the lower end, and a switch mechanism at the grip end. Patent 1574623. L. Grau, 8833 Bay Parkway, Bensonhurst, N. Y.

ELECTRICAL HAND POLISHING MACHINE.—An electrically driven machine convenient in form to permit of its being used manually. Patent 1575062. E. F. Kaiser, 355 W. 58th St., New York, N. Y.

SHIP TELEGRAPH.—Wherein all of the order bells keep ringing until that particular order is replied to by the receiver in the engine room. Patent 1575599. W. R. Hornberger, 2534 S. Shields St., Philadelphia, Pa.

METHOD OF PRODUCING, PHOTOGRAPHING AND PRESENTING A CROSS-WORD PUZZLE.—In motion picture form upon the screen, the picture being a running account of the puzzle. Patent 1575181. I. Schwartz, 111 W. Chester Sq., New York, N. Y.

DRAWING INSTRUMENT. — For making dots, adaptable for use by draftsmen, engineers, artists and others. Patent 1575209. A. T. Jespersen, 5116 Walnut St., Omaha, Neb.

HAIR WAVER.—That will produce a "Marcel" wave in a manner to give reasonable permanency to the wave. Patent 1575,578. E. Hagemeister, 126 W. 66th St., New York, N. Y.

BOTTLE STOPPER.—Which without the use of any tools can be quickly applied to or removed from a bottle. Patent 1575556. O. Eick, South Side Bank Bldg., St. Louis, Mo.

SHOE LAST.—Which gives to the shoe sole formed thereon a contour which conforms to the contour of the normal foot. Patent 1575527. G. H. Boehmer, Room 215, Hotel Times Square, 43d St., New York, N. Y.

CONDIMENT HOLDER.—By means of which the condiments may be singly or collectively dispensed, and protected against moisture. Patent 1575506. J. H. Rogers, 1180 Broad St., Newark, N. J.

MAGAZINE PENCIL.—Using interchangeable leads, the leads being advanced to the point by means of a needle. Patent 1575502. J. E. Platon, Smalandsgatan 30, Jonkoping, Sweden.

IRONING BOARD. — Which is extremely light yet strong, and adapted to be effectively held on a supporting stand. Patent 1575494. F. A. Lavendier, 53 Exchange St., Pawtucket, R. I.

DISPLAY CONTAINER.—For packing confectionery, medicines and similar commodities, when open may be positioned to display its contents. Patent 1575467. A. M. Van Wagenen, Jr., 364 Washington St., Norwich, Conn.

REENFORCED FABRIC.—For binding blankets and other articles, a reenforced section extending the full length of the fabric. Patent 1575428. S. H. Laury, 450 West Hight St., Carlisle, Pa.

WIRELESS COMMUNICATION.—By means of a transmitting antenna comprising a vacuous enclosure and an insulated plate disposed therein, said plate being adapted to be utilized for radiating high frequency currents. Patent 1575980. W. S. Ferdon, 5425 Pasea, Kansas City, Mo.

RECEIVING ANTENNA FOR WIRELESS TELEGRAPHY OR TELEPHONY.—In the form of a connecting plug whereby an apparatus for receiving wireless communications may be connected to an electric lighting power circuit. Patent 1575824. C. H. Eiffert, 901 Maiden Lane, Roanoke, Va.

ELECTRIC LIGHT FIXTURE.—For producing soft subdued and shadowless light and at the same time evenly illuminating an entire room. Patent 1574296. V. LeBeau, c/o Chas. I. Denechand, 406 Hibernia Bank Bldg., New Orleans, La.

ELECTRICAL HEATER.—Which makes use of the action of eddy currents in a substantially solid core of preferably magnetic material. Patent 1577276. W. Whitten, 301 Germania Ave., Schenectady, N. Y.

INSULATOR AND FASTENER FOR AERIALS.—Particularly intended for fastening and insulating indoor aerials to walls, and moldings, permitting the aerial to be securely held at intervals. Patent 1577230. E. A. Hirschy, 264 W. 23rd St., New York, N. Y.

ELECTRODE END CAP.—In which the open end is formed with an extended flange permitting of easy application and preventing tearing. Patent 1579118. E. Kleinman, c/o H. Caminer Bayreuther Strasse 26, Berlin W. 62, Germany.

ATTACHMENT FOR SADIRONS.—In the form of a thermally actuated signal, for use with electrically heated irons, to indicate the heat. Patent 1577127. J. D. Kaltenback and J. Stoll, 34 Ellis St., San Francisco, Calif.

ELECTRICAL CONTACT FOR TERMINALS OF VACUUM TUBES.—Whereby a simple attachment to the ordinary prongs will insure a substantial and sure contact. Patent 1579,156. J. H. Siemann, 283 11th St., Brooklyn, N. Y.

Of Interest to Farmers

MARKER FOR CORN PLANTERS.—Including devices for marking places in the ground where the seeds have been dropped. Patent 1574161. J. H. Long, R. No. 1, Ashtabula, Ohio.

POWER CULTIVATOR.—In connection with which two operators are employed, one to manipulate the power, the other to adjust the ground engaging implements. Patent 1575946. M. S. Sullivan, 248 Congress St., Charleston, S. C.

Mere Skill Not Inventive Genius

INVENTORS and manufacturers often attempt to secure patent protection on structural novelties and are surprised to learn that their ideas are not patentable. The reason the Patent Office fails to agree with the view of the inventor is made clear in a recent case in which the United States Supreme Court upheld the decision of a lower court that no patent could be issued for a chute for "wet" concrete. The patent was applied for in 1908, when apparently nothing of the kind had been patented. The court, however, held that the combination did not constitute an invention because there were in existence devices for handling other materials, so similar that it took only the application of engineering ingenuity to adapt them to the particular use.

The decision says:

"To say nothing of the universally known methods and appliances for raising and distributing water, there were ready at hand widely used and generally understood appliances for the elevation and distribution of mobile substances, such as grain and coal, which involved, both in principle and in practical detail, all the elements described in the claims."

Silk Patents to Rent

SILK is now being manufactured from wood at the rate of 150,000,000 pounds a year, a greater volume than the silkworm produces. Some of the American cotton and woolen mills, users of artificial silk, have been in Germany seeking processes for the manufacture of this product.

Recently, however, sixty or seventy German patents for the manufacture of artificial silk, cotton and wool from trees were found among the patents controlled by the Chemical Foundation, Inc. They were scattered here and there through 7,000 other patents and had been ignored. They will now be leased to any corporations which are owned by Americans to the extent of 75 percent at least.

To Legalize Fixed Prices

LEADING manufacturers are indorsing the Capper-Kelly bill recently introduced in Congress to legalize fixed price agreements between manufacturers and dealers.

The bill provides that "in contracts relating to the sale or resale of an article of commerce, the genuineness of which is attested by the trademark or special brand of any grower, producer, manufacturer, or other trademark proprietor who is in fair and open competition, actual or potential, with other growers, manufacturers or owners of similar or competing articles, which contracts are made by the owner of such articles, hereinafter referred to as the vendor, with wholesale or retail dealers, hereinafter referred to as vendees, ...it shall be lawful for such vendees to agree to sell such articles at the prices prescribed by such vendor and such agreement shall not be construed as against public policy or in restraint of trade."

One manufacturer sums up the attitude of the proponents of the bill by saying, "The manufacturer of branded goods is entitled to protection against the type of retailer who uses his merchandise as a football."

MOWING MACHINE.—Having means for turning over the outer edge of a swath to clear the space for the cutting of next swath. Patent 1576878. J. G. Thynne, Panstowe Ranch, Tulameen, B. C., Canada.

BEET TOPPER.—Adaptable as an auxiliary to a suitable farm implement, for acting as a rotary topper for the special purpose indicated. Patent 1578283. E. J. Hammer, Miller City, Ohio.

Of General Interest

IMPROVED PASTE TUBE CAP.—Adapted to collapsible paste tubes, easily operated for allowing the discharge or cut-off of the paste and possesses positive non-losable features. Patent 1570238. J. R. Gibson, 38 S. Dearborn St., Chicago, Ill.

PENCIL.—Of the self-feeding type, with mechanism whereby the lead may be moved in either direction longitudinally. Patent 1571120. W. K. Holmes, 135 Kenmore Place, Brooklyn, N. Y.

COMBINED REFRIGERATOR AND DISPLAY COUNTER.—For use in retail stores, to function as a medium of display and a storage place for relatively large cuts of meat. Patent 1570811. E. A. Wilkinson, 2649 Van Ness Ave., San Francisco, Calif.

CONTAINER.—For general use, provided with body of sheet material and may be collapsed to occupy very small place when not in use. Patent 1571089. H. L. Carpenter, c/o Carpenter Container Co., 1 Broadway, New York, N. Y.

SNAP FASTENER.—Which is flexible in its connection, strong, and liable to the minimum extent to work loose. Patent 1571117. H. H. and S. Guttman, c/o Times Clothes Shop, Room 605 Times Bldg., Broadway, New York, N. Y.

SINK.—Constructed to permit tea kettles and similar vessels to be placed directly beneath either faucet, the vessels being filled without being tilted. Patent 1569978. C. E. Howard, 6507 Makee Ave., Los Angeles, Calif.

ARTIFICIAL BAIT.—In which the hooks are ordinarily housed, but become exposed upon the bait being taken by a fish. Patent 1571770. G. E. Fenner, Oxford, Wis.

ICE BOX.—For cooling the contents of sealed bottles, the bottles being exposed in tubes to water chilled by melting ice. Patent 1571342. C. Paige, Nowata, Okla.

CONCRETE COLUMN.—Wherein the reinforcing is arranged in horizontal position, and the stresses distributed evenly throughout. Patent 1571799. A. H. Reeves, 61 Milford Ave., Newark, N. J.

COLLAR BUTTON.—Which when closed will be substantially flat and will firmly grip the material around the buttonhole. Patent 1571780. J. F. Ahrens, c/o King Collar Button Co., 729 Broadway, New York, N. Y.

NURSING BOTTLE HOLDER.—Adapted to support the bottle in an inclined position in order that the contents may be readily extracted. Patent 1571826. J. J. Wellenhoffer, 42 Seneca St., Salamanca, N. Y.

SUBMARINE.—Comprising a central resistant body and non-resistant end portions acting as water-ballast tanks, and torpedo tube housings. Patent 1571833. V. De Feo, c/o G. Capuccio, Via Arsenale N. 17, Turin, Italy.

FABRIC FURNITURE SPRING.—Consisting of a plurality of intertwisted wire cables, especially designed for beds, couches or the like. Patent 1571858. V. Massacese, c/o Attilio Verna, 476 9th Ave., New York, N. Y.

ADJUSTABLE SUPPORT.—Particularly applicable to chair backs, but in any other connections where an adjustable support is necessary. Patent 1571509. T. W. Connolly, Los Angeles, Calif.

AUXILIARY EYEGLASSES OR SPECTACLES.—That may be applied to ordinary glasses, in cases where an oculist may prescribe colored or prescription glasses. Patent 1571848. W. Lobenstein, 255 Martense St., Brooklyn, N. Y.

COLLAPSIBLE BOX.—In which the end, side, top and bottom sections, can be readily separated and packed flat for shipment. Patent 1572788. A. Gordon, 5618 2nd Ave., Brooklyn, N. Y.

BEAD WIRE.—Allowing the threading of beads without the employment of a separate needle, the needle being an integral part thereof. Patent 1572749. S. Mollengarden, c/o Royal Importing Co., 220 5th Ave., New York, N. Y.

EXTENSION ARM FOR PULLEY LINES.—Which may be mounted on the outside of a window, and readily swung in when the window is open. Patent 1572819. R. H. Smith, 916 Prospect Place, Brooklyn, N. Y.

SPECTACLES.—Having means for retaining the same against accidental displacement from applied position, without discomfort to the wearer. Patent 1572733. P. H. McCourt, 20th and Eugenia Sts., St. Louis, Mo.

GREASE DISPENSING DEVICE.—Adapted to be held in close proximity to the top of a stove, and will right itself after being tilted. Patent 1572762. A. H. Brunner, Carbondale, Ill.

BRAKE-LINING RACK.—On which rolls of brake lining or similar material may be displayed and the material removed in desired lengths. Patent 1572340. E. Warren, 201 Kinsey St., Peoria, Ill.

MEANS FOR PREVENTING ADHERENCE OF CAST METAL TO THE MOLD.—Comprising a substance containing an appreciable quantity of combined nitrogen in the form of a nitride of titanium. Patent 1570802. F. von Bichowsky, Glendale, Calif.

INDEXING DEVICE.—Which will visually index the contents of loose leaf binders, and make the contents instantly discernible. Patent 1571479. F. W. Huber, 504 Cole St., San Francisco, Calif.

PLACE CARD.—Formed from a matchbook, by adding to the same a support which will serve as a prop to hold the book in inclined position. Patent 1573748. S. Rosenstein, c/o Owname Renewable Matchbook Co., 475 Broadway, New York, N. Y.

POCKET LICENSE CONTAINER OR HOLDER.—Of cylindrical form, capable of attachment to a key ring, or to a watch chain, to be always at hand. Patent 1573663. W. Warren, c/o Richard Mfg. Co., Newport, R. I.

FOUNTAIN PEN.—Adapted to enable the user to write in ink of a plurality of colors, readily interchangeable. Patent 1573699. W. J. Giovannetti, 216 De Graw St., Brooklyn, N. Y.

COUPLING.—Especially adapted to be associated with air hose or similar pipe lines utilized for the transmission of fluid under pressure. Patent 1572979. E. A. Whybrew, 1312 Harber St., Port Huron, Mich.

MEANS FOR INTENSIFYING REPRODUCED TONES.—And step by step harmonizing all the different elements that enter into the reproduction and amplification of phonograph records. Patent 1573265. J. Mersman, c/o Mersman & Co., Ottawa, Ohio.

CLOTH.—Which may be easily produced with ordinary knitting machines, ornamental strips being utilized to produce a facing. Patent 1573788. O. C. Wiese, c/o Salomon Fromm, 93 Underhill Ave., Brooklyn, N. Y.

ROPE-END STOPPER.—Which may be readily applied to the sheared end of a rope in order to prevent unravelling. Patent 1573,737. W. G. Norman, 405 W. 45th St., New York, N. Y.

SHOEHORN.—Capable of folding, which can be suspended from a button, supported on a key ring, and occupies but very small space. Patent 1573729. H. Martin, 1449 E. 4th St., Brooklyn, N. Y.

COLLAPSIBLE BAG.—Occupying but small space in a trunk, but convenient for short trips when expanded for use. Patent 1573,721. C. H. Loeffler, 1206 Hancock St., Brooklyn, N. Y.

RENEWABLE MATCH BOX.—Including an ornamental cover of suitable material, which functions as an enclosure for "book matches." Patent 1573747. S. Rosenstein, c/o Owname Renewable Matchbook Co., 475 Broadway, New York, N. Y.

GUN SIGHT.—An adjustable rear sight, through which a point at the front may be viewed and brought into alignment. Patent 1572294. D. W. King, 12 Geary St., San Francisco, Calif.

SONG MOTION PICTURE FILM.—Whereby those in a theatre are guided in singing successive words, the singing not being dependent on timing the singing with the beat time of the music. Patent 1573696. M. Fleischer, 1600 Broadway, New York, N. Y.

BATHER'S ARTICLE.—Which may be worn on the person of the bather for the preservation of valuables or small pieces of property. Patent 1573239. R. E. Gilliland, 1110 Interstate Commerce Bldg., Washington, D. C.

CEMENT-BLOCK MOLD BOX. — Readily adapted for the production of a plurality of different kinds and sizes of blocks. Patent 1574612. R. A. Eaton, 21 9th Ave., Haddon Heights, N. J.

MEANS FOR AUTOMATICALLY CONTROLLING TRAFFIC.—Constructed in such manner that it may be caused to operate at predetermined intervals at street crossings. Patent 1574,606. H. Cook, Jr., 22 Hepworth Ave., Garfield, N. J.

Hardware and Tools

PIPE TONGS.—For drilling rotaries, especially adapted for gripping the pipes and couplings employed in an oil well. Patent 1572986. H. C. Brewster, Oil City Iron Works, Shreveport, La.

WEED PULLER.—For pulling weeds from grass lawns, easily inserted into the ground for engaging the root of the weed. Patent 1573222. M. T. Coelho, Box 89, Redwood City, Calif.

DRAWCUT SCISSORS.—Having a special joint construction which will impart a relative longitudinal motion to the blades during the cutting action. Patent 1573442. H. L. Feddersen, Oakland, Calif.

FLUE PIPE SUPPORT AND INSULATOR.—For maintaining a flue pipe in proper spaced relation to the inflammable parts of ceiling or roof. Patent 1573053. F. H. Gilbertson, 3835 Wisconsin St., Los Angeles, Calif.

RIPPER FOR WELL CASINGS.—Which may be inserted by ordinary well drilling machinery to cut a joint which is fast, and permit the casing removal. Patent 1574241. J. A. Francis, Grass Creek, Wyo.

Machines and Mechanical Devices

HOIST CONTROL UNIT.—For the purpose of preventing the over-winding and overspeeding of hoist mechanism employed in the skip of a mine shaft. Patent 1573256. H. H. Logan, c/o Duron Metal Co., 2649 N. Kildare Ave., Chicago, Ill.

MIXING AND EJECTING MECHANISM.—For use in conjunction with a horizontally disposed refrigerator cylinder for pitching the contents in opposite directions. Patent 1573,658. E. Thompson, P. O. A. 34 Esplanade, New Rochelle, N. Y.

DERRICK.—Having increased flexibility and adaptability of adjustment with respect to the relative positions of the sills. Patent 1573713. F. Hunt, 941 E. 156th St., New York, N. Y.

KNITTING MACHINE. — Having means whereby a single-feed stocking knitting machine may be converted into a two-feed striping machine. Patent 1573018. J. P. Primm, c/o Rome Hosiery Mills, Rome, Ga.

PLUNGER-CLEANING DEVICE.—Whereby a plunger may be inserted in a dust-proof casing and thoroughly cleaned of its coating material. Patent 1573720. E. C. Lampson, Jefferson, Ohio.

INTERLOCKING DEVICE FOR LAUNDRY MACHINES.—Which render it impossible to operate the machine when a door is open, or open a door when the machine is in operation. Patent 1574702. B. F. J. Schutt, 257 Hendrix St., Brooklyn, N. Y.

TOILET FLUSHING DEVICE.—Constructed to be turned on manually and remain open for a period, after which it automatically turns itself off. Patent 1574602. F. A. Burkhard, 158 E. 82nd St., New York, N. Y.

DISHWASHING MACHINE.—For domestic purposes, embodying a casing in which a plurality of dish supporting trays are sustained for rotary movement. Patent 1574452. W. L. South, 4708 Ingleside Ave., Chicago, Ill.

MULTIPLE FILM GUIDE MOUNTING.—For the progressive advancement of a continuous strip of film which is being dried or developed, without the film binding. Patent 1574591. A. L. Adatte, c/o Pathe Exchange, 1 Congress St., Jersey City, N. J.

AUTOMATIC SHIFTER.—Which will shift a valve, permit the valve to remain in one position a predetermined time, and again shift its position. Patent 1574604. W. T. Chamberlain, 56 W. 91st St., New York, N. Y.

ALARM CLOCK MECHANISM.—In which the gears are so connected to each other as to entirely do away with retaining pawls and ratchets. Patent 1575063. A. F. Kendle, Syracuse, Neb.

LASTING ATTACHMENT FOR STAPLING MACHINES.—So arranged that the upper is worked or drawn over the last immediately prior to the driving of the temporary fastening. Patent 1575279. A. H. Prenzel, Halifax, Pa.

PHOTOGRAPHIC PRINTING MACHINE.—By means of which prints may be taken from a negative in large numbers and at a high speed. Patent 1574687. A. C. Pillsbury, Yosemite National Park, Yosemite, Calif.

PIANO-LOCKING DEVICE.—A locking mechanism which will secure the sliding drawer arranged below the keyboard of a reproducing grand piano. Patent 1575532. I. E. and M. K. Bretzfelder, and J. Shady, c/o Krakauer Bros., Cypress Ave. & 136th St., Bronx, N. Y.

FRUIT PRESS DRIVE.—Wherein a spring is interposed between the pressing disk and the driving mechanism for maintaining the disk under tension. Patent 1576234. F. Cozzoli, 404 E. 2nd St., Plainfield, N. J.

Pertaining to Vehicles

SHACKLE-BOLT AND SPRING LUBRICATING MEANS.—Whereby not only the springs, but the shackle bolts of the springs may be lubricated at all times. Patent 1570746. J. M. Jackson, c/o Rope & Cordage Co., Parkersburg, W. Va.

COMBINED DUST CAP AND AIR SEAL FOR TIRE-VALVE STEMS.—Adapted to be automatically given locking engagement, when connected with pneumatic tires. Patent 1571865. G. W. Oakes, Crystal City, Missouri.

RADIATOR WITH REMOVABLE ELEMENTS.—In which the parts are held within a frame so as to allow them to be replaced in case of accident. Patent 1572792. H. R. Guyot, 54 Avenue Jean Jaures, Paris, France.

AUTOMOBILE LOCK.—Constructed in such manner that the operator will know that the locking has not been completed if the engine is still running. Patent 1573459. R. R. Stabler, c/o V. L. Gilpin, Canterbury Hall, Baltimore, Md.

TIRE INFLATING DEVICE.—Adapted to be operated from the engine of the automobile, especially designed for inflating tires of the balloon type. Patent 1573725. J. F. MacDonald, Hillsboro, New Brunswick, Canada.

COMPOSITION FOR TREATING BRAKE LININGS.—For softening hard, glazed, or burned automobile brake linings, and to prevent noise when the brakes are applied. Patent 1573468. F. E. Wieser, 50 Hathaway Ave., San Luis Obispo, Calif.

AUTOMOBILE WHEEL RIM.—By the use of which the tire may be expeditiously applied and removed. Patent 1572101. W. Bowles, Meadow Creek, W. Va.

SHOCK ABSORBER.—Whereby a piston associated with the spring mechanism is caused to operate against a fluid so as to reduce shock to a minimum. Patent 1572484. F. T. Homar, 721 N. 9th St., Tucson, Arizona.

VEHICLE FENDER.—A construction adapted for imparting to a motor vehicle the properties of a combined fender and bumper. Patent 1573243. J. B. Henry, 2125 Parkside Ave., Burlingame, Calif.

ANTIGLARE SHIELD.—For protecting the eyes of the driver from the glare of the sun when same is low in the sky. Patent 1573,272. G. E. Phillips, Box 474, Imola, Calif.

ROAD MAP AND REGISTRATION CERTIFICATE HOLDER.—In which a chart, registration card or the like may be held conveniently and plainly exposed to view. Patent 1573,447. J. C. Prewitt, c/o S. P. Milling Co., Santa Margarita, Calif.

SIGNALING APPARATUS. — Arranged at each end of a vehicle, for simultaneously moving to indicate right or left turns. Patent 1574734. A. McLaren, 366 Herkimer St., Brooklyn, N. Y.

AUTOMOBILE TIRE.—Which when deflated can be quickly and easily placed on the felloe, and when inflated will retain its position. Patent 1574611. A. F. Dembek, 230 Van Siclen Ave., Brooklyn, N. Y.

HEADLIGHT LENS.—Which by reason of its special form of construction will give full road illumination, and will prevent glare. Patent 1574607. G. E. Corcoran, c/o Munn, Anderson & Munn, Woolworth Bldg., Broadway, N. Y.

MOUNTING FOR WINDOW GLASS.—Especially adapted for use in connection with doors, windows or other openings of an automobile body. Patent 1572427. M. Fuller, 16th & Carr Sts., Chattanooga, Tenn.

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Western Advertising Office, Wilson and Galey, Harris Trust Building, Chicago, Ill.

Vol. 134, No. 6. Published monthly. Entered as second class matter, June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879.

Price, 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions, and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5.00 a year, postage prepaid.

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Lack of space makes it impossible to give many cross-references or to enter a given reference in more than one place. Each article is therefore entered where it is believed it will be most easily found. In every case, the general subject should be sought rather than the supposed specific title of an article. We call special attention to the classifications "Aviation," "Radio," etc., under which many items will be found whose location otherwise would be very puzzling. The asterisk (*) indicates that the article in question is illustrated.

Strands of steel are fed onto a long steel table—the loose end is "looped" around, and fed back for the next rolling or reducing operation

Steel Strands of Strength for Your Car

In go billets of steel; out come rods of steel. In go the rods of steel; out come blazing bright steel strands, snaking around the sweating giants who "loop" the white hot metal through successive reducing operations. It is one of an awesome series of fiery spectacles in the great Timken steel works, whose output of electric steel is the largest in the world. It is the birth of Timken Tapered Roller Bearings at the rate of 132,000 daily!

Absorbing such an output are Timken-equipped devices of every sort, including 83% of all American makes of cars and trucks. Transmissions, differentials, pinions, worm gears, rear wheels, front wheels, steering pivots and fans are Timken-mounted.

On Timkens more of the power does useful work since friction is far less. With Timkens fine alignment and quiet are preserved, because heaviest stresses from all directions are resisted by Timken Taper and Timken "positive roll alignment." Timkens simplify design—reducing weight—influencing economy. And only Timken makes its own steel, assuring the most enduring material wherever Timken Tapered Roller Bearings are used.

So they help you to identify cars of higher value, lower operating cost, and longer life.

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C A N T O N , O H I O

TIMKEN
Tapered
ROLLER BEARINGS

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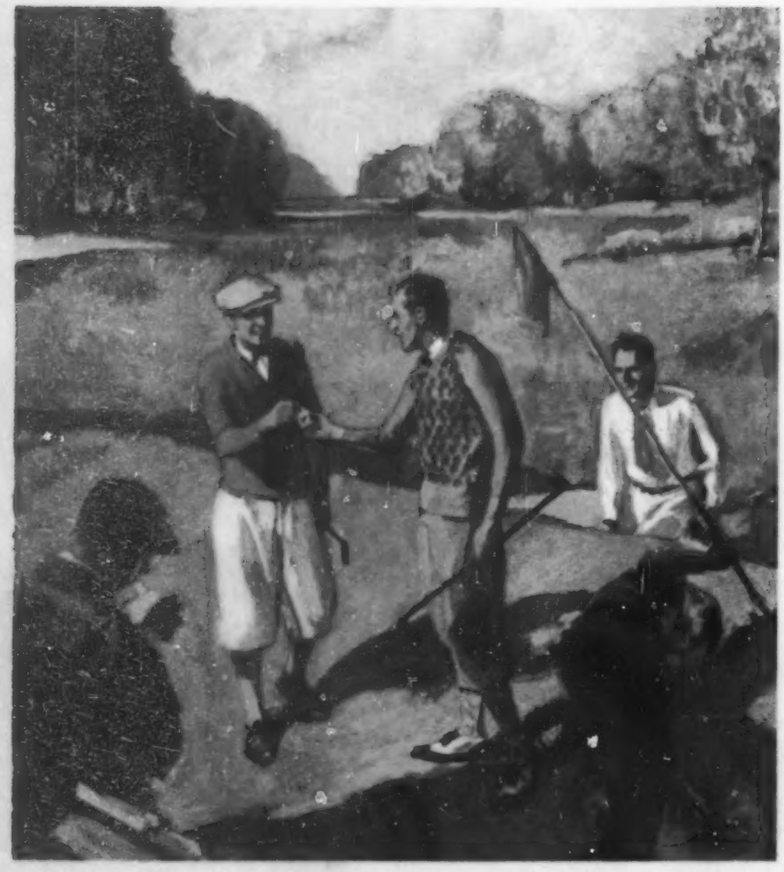
When the first glorious day of golf is over—and the final putt sinks in the 18th cup—when the tense moments end in soft, mellow twilight
—have a Camel!



No other cigarette in the world is like Camels. Camels contain the choicest Turkish and Domestic tobaccos. The Camel blend is the triumph of expert blenders. Even the Camel cigarette paper is the finest—made especially in France. Into this one brand of cigarettes is concentrated the experience and skill of the largest tobacco organization in the world.

WHEN it's glorious evening on the greens. And the last long putt drops home on the 18th hole. When spring sunset colors the world with its soft magic light—*have a Camel!*

For, all the world over, Camel adds of its own friendly goodness to exhilarating days and restful evenings. Camel fragrance and taste add joyous zest to healthful hours in the open. Camels never tire your taste, or leave a cigaretty after-taste, no matter how liberally you smoke them. This is the inside story of Camel success—their choice tobaccos and perfect blending make them the utmost in cigarettes money can buy.

So, this fine spring day, as you eagerly start for life's fairway. When your first glorious birdie ends its breathless flight, as you leave the long course to start home, tired and joyous — taste then the smoke that's admitted champion among the world's experienced smokers. Know, then, the mellowest fragrance that ever came from a cigarette.

Have a Camel!

Our highest wish, if you do not yet know Camel quality, is that you try them. We invite you to compare Camels with any other cigarette made at any price.

R. J. Reynolds Tobacco Company
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